OTAY WATER DISTRICT

2015 Integrated Water Resources **Plan Update**

FINAL | June 2016

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Otay Water District

2015 INTEGRATED RESOURCES PLAN UPDATE

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Abbreviations

AECOM	AECOM Technical Services, Inc.
AFY	acre-feet per year
AWP	advanced water purification
AWPF	advanced water purification facility
AWTP	advanced water treatment plant
CEA	Comisión Estatal del Agua de Baja California
cfs	cubic feet per second
CILA	Comisión International de Limites y Agua
CRA	Colorado River Aqueduct
DPR	direct potable reuse
ECRWIP	East County Regional Treated Water Improvement Program
ESP	Emergency Storage Project
FCF	flow control facilities
gpcd	gallons per capita per day
HWD	Helix Water District
IBWC	International Boundary and Water Commission
IPR	indirect potable reuse
IPR/DPR	Indirect/Direct Potable Reuse
IRP	Integrated Water Resources Plan
LSME	La Mesa Sweetwater Extension
MCL	maximum contaminant level
METRO	City of San Diego's Metropolitan Sewerage System
mgd	million gallons per day
MWD	Municipal Water District of Southern California
OWD	Otay Water District
PDMWD	Padre Dam Municipal Water District
RO	reverse osmosis
RSWRF	Ray Stoyer Water Reclamation Facility
RWCWRF	Ralph W. Chapman Water Reclamation Facility
SBWRP	South Bay Water Reclamation Plant
SDCWA	San Diego County Water Authority

SIDUE	Secretaria de Infraestructura y Desarrollo Urbano del Estado
SPI	Separation Processes, Inc.
SWP	State Water Project
TDS	total dissolved solids
UWMP	Urban Water Management Plan
WFMP	Water Facilities Master Plan
WRF	water recycling facility
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

Background

The Otay Water District (OWD) provides potable water, recycled water, and sewer service to approximately 217,000 customers within 125.5 square miles of southeastern San Diego County. Figure ES.1 provides a map of the area serviced by OWD, including Bonita, Chula Vista, Eastlake, El Cajon, Jamul, La Mesa, Otay Mesa, Rancho San Diego, and Spring Valley.

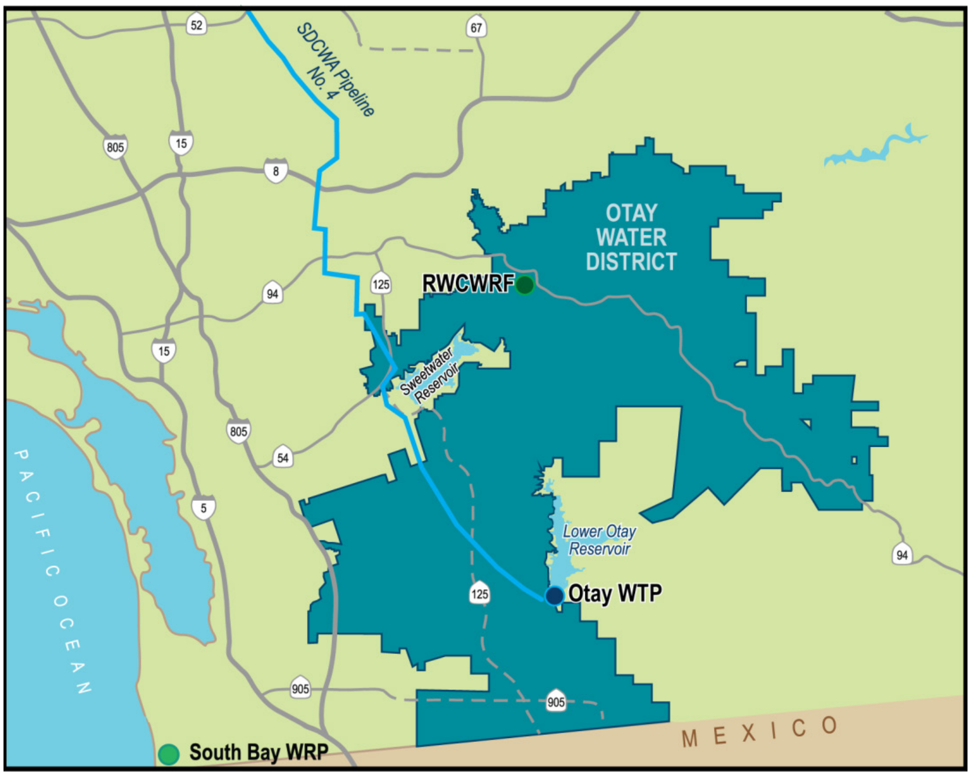


Figure ES.1 Otay Water District Service Area

The region experiences minimal precipitation to provide local water sources and depends on imported water to meet the potable and non-potable demands. The majority of imported water is supplied by the State Water Project (SWP) and the Colorado River Aqueduct (CRA) purchased through the Municipal Water District of Southern California (MWD) and San Diego County Water Authority (SDCWA).

This dependence on imported water poses challenges to meet water demands reliably and cost-effectively in the coming years. The continuing drought in the region has adversely affected the reliability of imported water supplies and created a need to examine potential future supply options. The uncertainty of available imported water supplies due to drought, or emergency seismic conditions, as well as the rising costs of imported water, the OWD is moving towards less dependence on imported water and need to examine a wide variety of supply options that will best diversify the supply portfolio to meet changing conditions in the future.

This 2015 update to the 2007 Integrated Water Resources Plan (IRP) serves to examine alternative supply options and their potential to meet the needs of the OWD under a wide variety of future conditions through 2040.
Introduction

Several factors contribute to the need for increased local water supplies. The population that the OWD serves is estimated to increase from approximately 217,000 in 2015 to 307,877 by 2050. The average annual rainfall is near 10 inches but prolonged drought conditions have resulted in consecutive years of less than normal precipitation affecting the groundwater available locally and from the SWP and the CRA.

The OWD currently relies on imported water to meet all of its potable and some of its non-potable demands. This reliance translates to a greater risk from drought and seismic events that can affect the availability of imported water. The development of local water sources to meet the long-term demands of a growing population is required to reduce dependence on water supplies with uncertain futures.

Existing Water Supply

The OWD is separated into three service systems, the North, Central, and Otay Mesa Systems. The potable water supply is supplied to all systems by imported water sources. The SDCWA provides water through Pipeline #4 and the Helix Water District's (HWD) Levy WTP. Recycled water is only delivered to the Central Area System following treatment at the Ralph W. Chapman Water Reclamation Facility (RWCWRF) and the South Bay Water Reclamation Plant (SBWRP).

Table ES.1 provides the water facility capacities and agreements in place for the 2015 IRP Update.

Table ES.1 Water Facility Capacities and Agreements

Supply Source	Baseline Capacity(1)	Notes
Imported		
SDCWA's treated water through Pipeline # 4	121.5 mgd	[Capacity]
City of San Diego’s Otay WTP	10 mgd	[Agreement]
Helix’s Levy WTP	12 mgd On-Peak, 16 mgd Off-Peak	[Agreement]
Total Imported Supply	143.5 - 147.5 mgd	
Recycled		
OWD’s Ralph W. Chapman WRF	1.3 mgd	[Capacity]
City of San Diego’s South Bay WRP	6 mgd	[Agreement]
Total Recycled Supply	7.3 mgd	

Note:
(1) Data from OWD Water Resource Master Plan, May 2013

Projected Water Supply Gap

The OWD historical demands were evaluated to determine the water demand forecast. The projected demands for the 2015 IRP are significantly lower for 2050 than projected in prior reports. This decrease is a result of reduction in growth projections, drought tolerant landscaping trends, and water conservation by OWD customers.

Per the 2015 WFMP, the current demand of 37,000 acre-feet per year (AFY) is anticipated to increase to approximately 52,000 AFY by 2050. There is no potable water supply gap if all future demands are met through the purchase of SDCWA imported water. The continued reliability of these supplies remains uncertain. The seasonal variations affecting the demands for recycled water create a supply gap during the summer months. Production limits at SBWRP are inadequate to offset this gap even with over 40 MG of recycled water storage.

Water Supply Projects

The OWD objectives for this IRP update place an emphasis on reliability, flexibility, and diversity which can be met by development of additional water supplies in an effort to reduce dependence on imported water.

Projects include conservation, groundwater, imported water for potable use, Indirect/Direct Potable Reuse (IPR/DPR), potable water treatment options, ocean desalination, and recycled water for non-potable use. The projects are described in detail in Section 4 and are evaluated based on their potential to further the mission statement of OWD:

> *"To provide high value water and wastewater services to the customers of the Otay Water District, in a professional, effective, and efficient manner" (Otay, 2015).*

Table ES.2 provides recommended water supply projects that will contribute to the long-term goals of the OWD in moving away from reliance on imported water.

Table ES.2 2015 IRP Recommended Water Supply Projects

Source Type	Supply Project	Description
IPR/DPR with Local Supply	PDMWD's Advanced Water Purification Project	Contribute funds for construction of AWFP
	Advanced Purification at RWCWRF or Spring Valley Plant	Upgrade RWCWRF to advanced purification facility or construct a new AWPF where more sewer flows are available, augment supplies in Sweetwater Reservoir
	City of San Diego's Pure Water Program	Contribute to AWPF at South Bay WRP that would augment water supplies in Otay Reservoir
Ocean Desalination	Rosarito Desalination Project	Purchase water from Rosarito's planned ocean desalination plant
Imported Water for Potable Use	Cadiz Water Conservation, Recovery, and Storage	Purchase 5,000 AFY from Cadiz Valley
Groundwater	Rancho del Rey Well	Produce up to 600 AFY (requires treatment and brine disposal)
	Lot 7 Well	Produce up to 320 AFY (requires treatment and brine disposal)
Recycled Water for Non-potable Use	City of San Diego's South Bay WRP	Increase amount of recycled water purchased at SBWRP
	Chula Vista MBR	Joint City of Chula Vista/OWD tertiary treatment facility to produce Title 22 recycled water

Section 1

INTRODUCTION

1.1 Project Background

The primary purpose of an IRP is to identify and conceptually develop a diverse range of water supply projects to meet long range water supply needs. This IRP is an update of the 2007 IRP and begins with a presentation of the OWD service area and existing supply and demand characteristics. Demand projections from the 2015 Water Facilities Master Plan (WFMP) through planning year 2050 were utilized to identify the future water supply gap. The results of exploring the various supply options recommended in the 2007 IRP are reflected herein. Potential water supply sources were updated and new sources were identified to meet OWD established planning objectives. The OWD objectives for this IRP place emphasis on reliability, flexibility, affordability, and diversity aimed at decreasing dependence on imported SDCWA supplies.

1.1.1 District Service Area

The OWD is located within San Diego County, east of the City of San Diego on the U.S. – Mexican border in Southern California. The OWD has a service area of 126 square miles. The OWD provides water and wastewater service to parts of the following communities: Chula Vista, Eastlake, Jamul, Otay Mesa, Rancho San Diego, La Presa, and Spring Valley. Figure 1.1 shows the OWD service area.

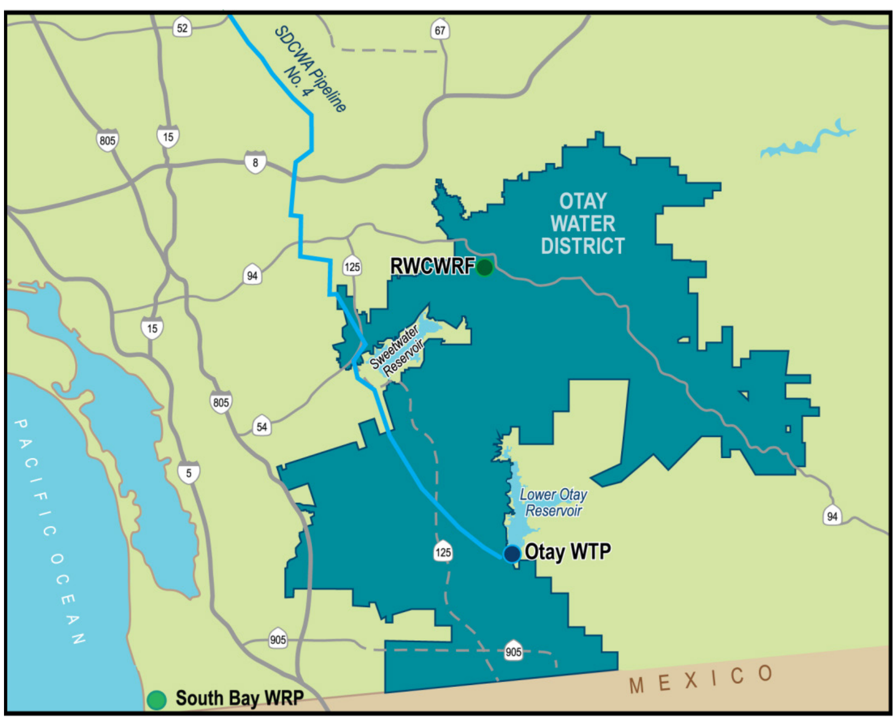


Figure 1.1 Otay Water District Service Area

1.1.2 District Land Use Characteristics

According to OWD's 2015 WFMP, approximately 64 percent of OWD's customers are single-family residences, while much of the anticipated development will be both single and multifamily residential. The relative composition of OWD's customers is expected to remain constant, since the commercial, industrial, and institutional sectors will grow proportionally in order to support the residential development.

1.1.3 Population and Growth

The OWD was formed in 1956 by local residents and landowners in response to the need to address declining quality and quantity of water supplies in the arid region of San Diego County. Since that time, OWD has been managing water and wastewater services to meet the needs of its growing population of customers.

OWD provides potable water, recycled water, and sewer service to approximately 217,000 residents within its service area (Otay, 2015). The 2015 WFMP estimates that the population served by OWD in the year 2050 will be approximately 307,877.

The long term population growth rate has historically been about 3 percent per year. However in recent years, growth has occurred at a reduced rate due to the downturn in the economy. The updated SANDAG forecast shows a long term growth rate of 1 to 1.5 percent per year through 2050. Growth is expected to slow as the availability of developable land decreases over time.

1.1.4 Climate

The climate in San Diego County is characterized as Mediterranean, with mild temperatures and low annual rainfall. Temperatures are mild on the pacific coast year-round, and tend to be slightly more extreme inland at OWD – with warmer temperatures in the summer and cooler temperatures in the winter. Average annual rainfall for OWD is approximately 10 inches.

1.1.5 District's Water Supply

The OWD is a member agency of the SDCWA, which is in turn a member of the MWD, the regional water wholesaler for Southern California, providing supplemental water to over 17 million people in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura Counties. Together, SDCWA and MWD provide imported water from Northern California and the Colorado River to their member agencies throughout Southern California. MWD augments its imported water supplies with water transfers and groundwater banking programs. SDCWA augments its imported water supplies with water transfers, seawater desalination, additional water transfers, and groundwater programs.

Currently, the OWD relies on imported water to meet all of its potable water demands and some of its non-potable demands. This imported supply is delivered both treated and untreated (raw) through the SDCWA aqueducts. The raw water is treated at either MWD's R.A. Skinner WTP, SDCWA's Twin Oaks Valley WTP, or HWD R.M. Levy WTP. The treated water is provided through agreements with neighboring water agencies and delivered to the OWD.

1.1.5.1 Water Supply Reliability

Because the OWD relies on imported water to meet a large portion of its water demands, it has greater risk in terms of potential droughts and seismic events that could reduce or terminate the amount of imported water available. Although both SDCWA and MWD have long-range water supply plans that indicate they will be able to meet full-service water demands of their member water agencies through 2040, these plans make a number of assumptions.

In 2016, MWD released its update to its 2010 IRP. This 2015 IRP update concluded that the existing supplies and storage resources are insufficient to meet future demands through 2040 without new investment. The 2010 MWD IRP update stated that MWD has enough water to meet full service demands through 2025. However, many of MWD's assumptions have been invalidated by the unprecedented drought.

Eight of the ten years from 2006 to 2015 saw runoff levels of below normal, dry, or critically dry conditions. The drought has affected the reliability of imported water from the SWP and the CRA. Groundwater levels are also lower than projected due to the drought, with groundwater recharge unable to keep up with pumping.

While the latest update projects that future demands will be lower than expected due to slower than predicted population growth and continued conservation, the supply is not as robust as estimated in the 2010 MWD IRP. The difficulty in predicting future hydrology increases the need for diverse and flexible resources to ensure performance under a wide range of future conditions.

Therefore, it is prudent for OWD to explore development of local water sources as a way to hedge against the supply risk for imported water. In addition to reducing reliance on imported water, local waters supplies may be more cost-effective long term. This is especially important because imported water costs are expected to increase significantly due to the investments being made by MWD and SDCWA to improve supply reliability.

1.2 Problem Statement

Given the uncertainties surrounding imported water supplies as a result of potential on-going drought shortages, or emergency seismic conditions, as well as the rising costs of imported water, the reliance of OWD on imported water as their main supply source potentially poses challenges to fulfilling their organizational mission statement as stated below:

"To provide high value water and wastewater services to the customers of the Otay Water District, in a professional, effective, and efficient manner" (Otay, 2015).

The OWD, like many similar agencies in Southern California, is looking to reduce their dependence on imported water, and in doing so, to reduce operational costs and provide greater local control over their water resources and water management systems. To do this, OWD needs to evaluate a number of supply options and define the best supply portfolio for the future.

1.3 Purpose of the Integrated Water Resources Plan

This IRP developed for the OWD is intended to provide a flexible, long-term strategy for the evaluation and implementation of water supply alternatives, management, and inter-agency agreements needed to expand and operate the OWD water system consistent with the OWD's mission and values. The 2015 IRP Update provides an overview of water supply alternatives identified in the 2007 IRP and presents findings from recent studies on some of the alternatives previously identified. New supply alternatives will also be summarized and ultimately, the 2015 IRP provides recommendations for future studies and evaluations of preferred water supply alternatives.

An IRP involves the identification of the values and objectives of an organization, and then looks at possible supply-side and demand-side water management options in a consensus-building process to develop a comprehensive plan to meet the defined objectives. The result is a defensible plan for the future development and management of the OWD that considers important objectives such as reliability, environmental protection, and water quality and that provides flexibility for changes and adaptation in the future.

In previous IRP updates, supply options were grouped into portfolios for evaluation against the objectives through specific performance measures. The portfolios were evaluated using commercial software that used models to simulate water demands and supplies under different hydrologic and operating scenarios, converting raw performance into standardized scores in order to rank portfolios. The IRP planning team used this process to determine the top performing portfolios.

The grouping of supply options into portfolios was not used in this IRP update. Supply options were instead evaluated individually for their ability to meet the OWD long term water management objectives.

Section 2

EXISTING WATER SUPPLY

Supply for OWD primarily comes from imported water provided by the SDCWA. Currently, OWD does not use any other local water sources, such as groundwater or seawater, to meet potable customer demands. Recycled water is supplied from OWD's RWCWRF and from the City of San Diego's SBWRP.

2.1 Water Supply Systems

The OWD service area is considered to be divided into three systems: North, Central Area, and Otay Mesa. As shown on Figure 2.1, these systems are geographically separated and operationally distinct. Each system receives imported water from one or more flow control facilities (FCF) on the SDCWA aqueduct. Each has its own storage and pumping facilities, as well as its own demands to serve.

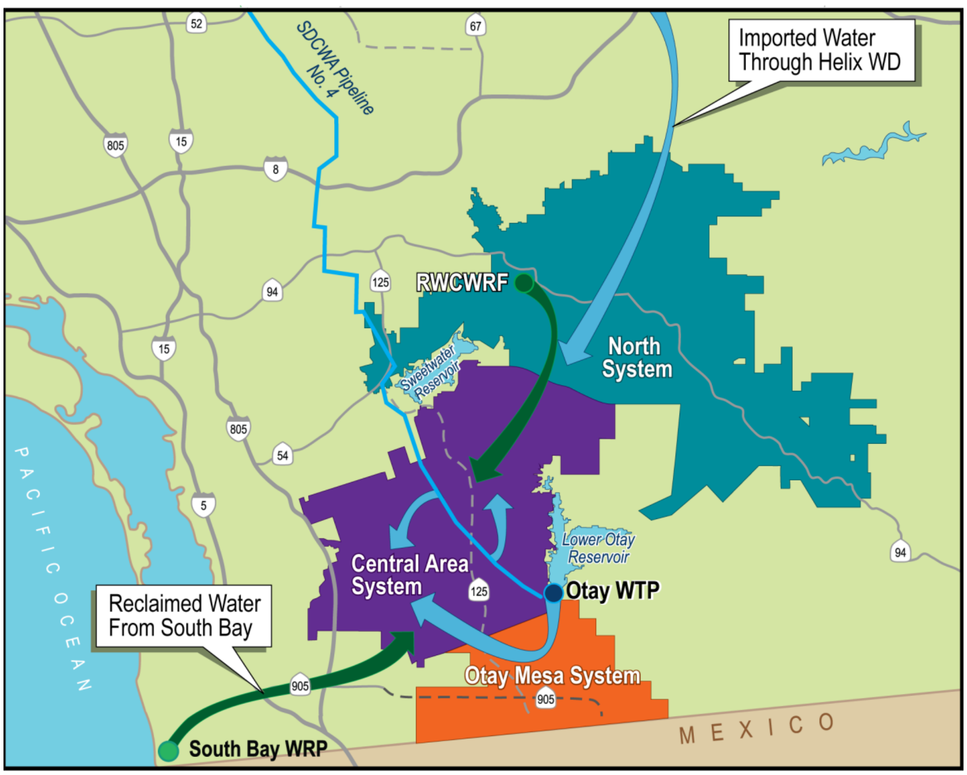


Figure 2.1 North, Central Area, and Otay Mesa Systems

The OWD service area is divided into five subsystems. These systems are known as La Presa System, the Regulatory System, the Hillsdale System, the Central Area System, and the Otay Mesa System. La Presa, Regulatory, and Hillsdale systems are grouped together into what is known as the North District. The Central Area and Otay Mesa systems make up the South District.

A schematic of the entire OWD system is shown on Figure 2.2. This schematic represents the major water facilities and conveyance infrastructure from the source to system demands. For purposes of the IRP, details of the facilities associated with the distribution system are not shown on this schematic.

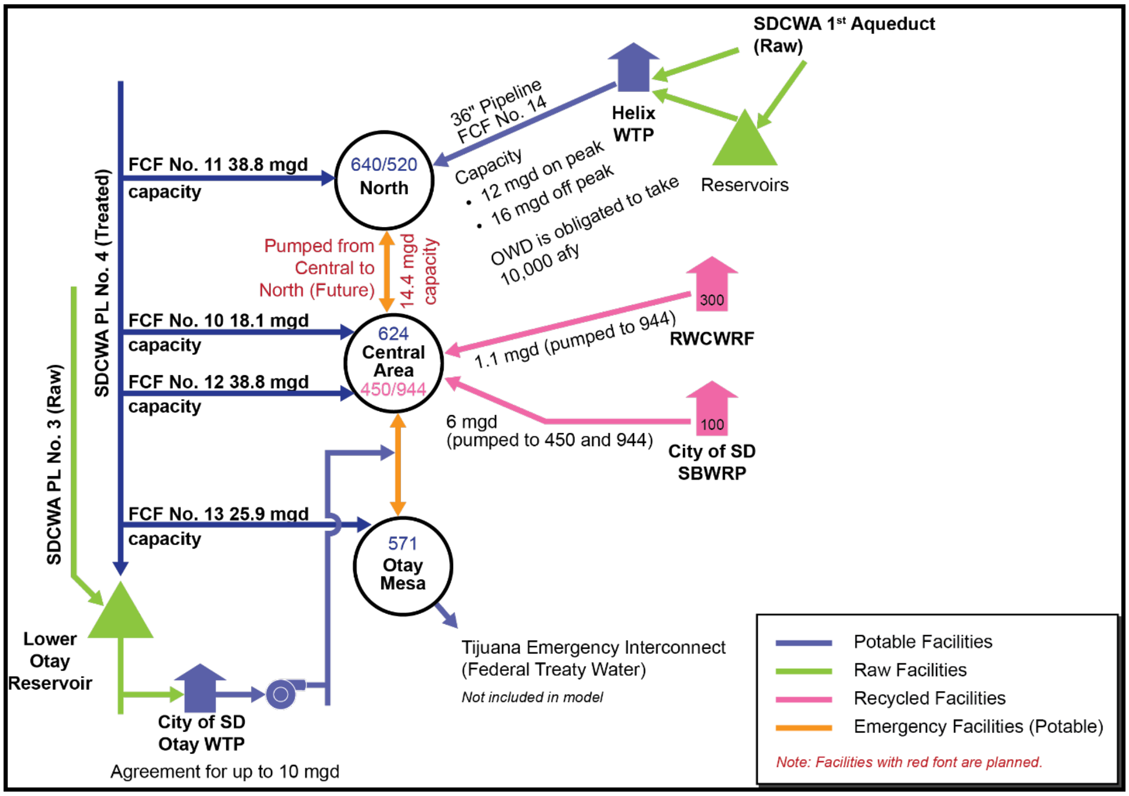


Figure 2.2 Baseline System Schematic

2.2 Potable Water Supply Delivery

2.2.1 North System

The North System primarily receives treated water from Helix Water District's Levy Water Treatment Plant. The water is supplied through a 36-inch diameter water transmission main with a total conveyance capacity of 16 mgd. The District's agreement with Helix Water District and SDCWA is for a water supply delivery of 12 mgd on-peak and 16 mgd off-peak.

In addition to receiving treated water from Helix Water District, the North System can use FCF No. 11 to divert a supplemental supply of water by gravity from SDCWA Pipeline No. 4 to the 640 and 520 reservoirs. Water then flows by gravity or is pumped from the reservoirs to La Presa, the Regulatory, and the Hillsdale systems of the service area. Flow Control Facility No. 11 has a meter capacity of 38.8 million gallons per day (mgd), or 60 cubic feet per second (cfs).

2.2.2 Central Area System

The Central Area System receives treated water from FCF No. 10 and FCF No. 12 on Pipeline No. 4 which is delivered to the 624 reservoirs. FCF No. 10 has a capacity of 18.1 mgd (or 28 cfs), and FCF No. 12 has a capacity of 38.8 mgd (or 60 cfs).

In addition, water treated at the City of San Diego's Otay WTP can be delivered to the Central Area System. OWD has an agreement with the City of San Diego to treat 10 mgd of raw water purchased from the SDCWA at the Otay WTP. This agreement is discussed in more detail later in this section.

2.2.3 Otay Mesa System

The Otay Mesa System receives treated imported water from FCF No. 13 on Pipeline No. 4. This water flows by gravity into the 571 storage reservoir from which it is pumped to reservoirs at a higher elevation to serve water demands. FCF No. 13 has a capacity of 25.9 mgd (or 40 cfs).

Similar to the Central Area System, the Otay Mesa System can also receive water treated at the City of San Diego's Otay WTP.

2.3 Recycled Water Supply Delivery

In addition to the potable water infrastructure described above, recycled water supplies are also delivered to the Central Area through pipelines from the RWCWRF and the SBWRP. The recycled water system is also shown on the schematic in Figure 2.2. Currently there is no system for recycled water in the North System and Otay Mesa System.

2.4 Emergency Supply Deliveries

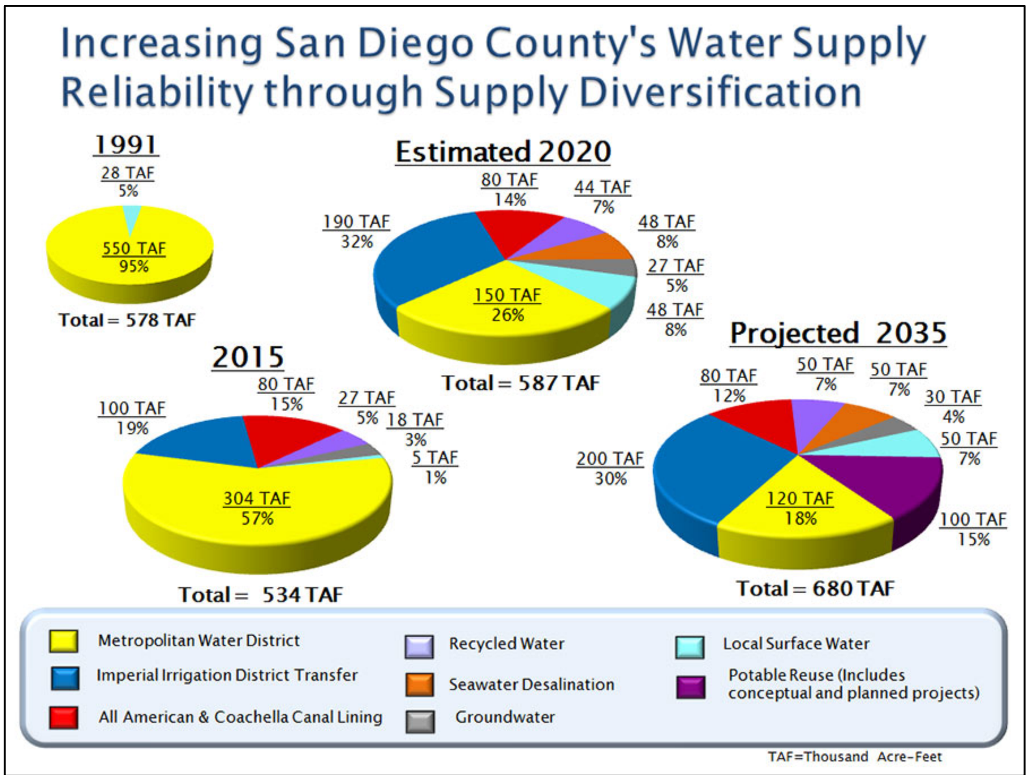
An interconnection pipeline between the Central Area and Otay Mesa Systems currently exists, and an interconnection between the Central Area and North District is currently in the planning and preliminary design stage. These interconnections allow transfer of potable water between systems and provide flexibility in the management of demands in the case of an emergency, such as an earthquake, that disrupts the normal operation of the SDCWA aqueduct. The interconnections are not intended for normal operating conditions. Additionally there exists a 13 mgd emergency interconnect between OWD and the City of Tijuana in Mexico. This interconnect can be used to deliver international treaty waters to Mexico, but was not evaluated in the IRP.

OWD has established a goal to sustain a 10-day outage of supply from the SDCWA Pipeline No. 4 at any time of the year without a reduction in service level. For emergency events longer than the 10-day aqueduct shutdowns noted previously, OWD will utilize emergency supplies provided by SDCWA's Emergency Storage Project (ESP). The ESP is designed to provide treated water service to all SDCWA member agencies during a two-month interruption in service of imported water deliveries into San Diego County. The ESP is sized to deliver up to 75 percent of each agency's peak two-month summer demand. The key facilities of the ESP include the Olivenhain Dam and Conveyance System, the Lake Hodges Interconnect, the San Vicente-Miramar Pipeline, and the expansion of San Vicente Reservoir.

2.5 Potable Water Supply

2.5.1 San Diego County Water Authority Imported Supply

Imported water from SDCWA is the primary source of water for OWD. OWD takes both treated water and raw water (indirectly) from SDCWA. Treated water from SDCWA is directly delivered to OWD's reservoirs through four flow control facilities on Pipeline No. 4. Raw water from SDCWA is first delivered to the Helix Water District's Levy WTP or the City of San Diego's Otay WTP for treatment and then it is conveyed to the OWD service area. The SDCWA supply diversification for 2015 is presented in Figure 2.3.



(Source: "Enhancing Water Supply Reliability." San Diego County Water Authority. N.p., n.d. Web. 16 June 2016. <http://www.sdcwa.org/enhancing-water-supply-reliability>.)

Figure 2.3 SDCWA Supply Diversification

The figure also shows the supply diversification estimated for 2020 and projections for 2035, which both include the increased local water supply provided by seawater desalination in Carlsbad. The Claude "Bud" Lewis Carlsbad Desalination Plant is producing approximately 50 mgd of water for San Diego County, reducing vulnerability to drought conditions. The plant meets about 7 percent of the region's water demand, decreasing the historical dependence on imported water. SDCWA is also investigating the potential of a desalination plant at Camp Pendleton.

MWD owns and operates the CRA, along with major reservoirs such as Diamond Valley Lake and Lake Skinner, 5 regional water treatment plants, and large transmission pipelines to move imported water to its 26 public member agencies. Over the last few years CRA supply, historically providing over 1.2 million AFY to the region, has been severely cut. This was due to the development of the California Plan for Colorado River, which forces California to live within a limited entitlement of Colorado River. MWD does have programs in place and is working on others in order to maximize supplies from the CRA and in certain years get back to the 1.2 million AFY level.

MWD is also the largest State Water Contractor, with a contract of 2.0 million AFY for SWP supply. The SWP is subject to extreme variability in hydrology due to a lack of storage. Although MWD has a contract for 2.0 million AFY, it rarely has received that (only in the very wettest of years). Average deliveries have been closer to 1.2 million AFY. In severe droughts, SWP supplies to MWD have been less than 0.5 million AFY.

MWD augments its imported water from the CRA and SWP with stored water in water banks such as Semitropic and Arvin-Edison, conjunctive use storage in local basins, and voluntary water transfers during certain dry years. MWD's IRP (2010) indicated that MWD would have the supplemental water to meet all of its member agencies' water needs through 2025, even during drought conditions. In 2014, MWD received only 5 percent of the contracted amount from the SWP. The IRP Update (2015) reflects the changing reliability of CRA and SWP as four consecutive years of drought have affected allocations from these supplies.

2.5.2 City of San Diego's Otay WTP

The City of San Diego's Otay WTP has an effective capacity of 34 mgd; however, currently operates at an average capacity of 15 mgd (Eric Rubalcava, personal communication, April 21, 2015). The City of San Diego uses approximately 8.5 mgd while Cal American Water is supplied an average of 6.5 mgd from the Otay WTP. The City will increase production from Otay WTP to supply an anticipated 2 mgd to the City of San Diego's service area located north of Highway 54.

OWD purchases raw water from the SDCWA for treatment at the Otay WTP. In 1999, OWD entered into an agreement with the City of San Diego to be provided 10 mgd of treatment capacity from the Otay WTP, if such surplus is available. Typically, OWD receives water from the City only during winter SDCWA shutdowns due to the costs being higher than SDCWA rates.

2.5.3 Helix Water District's Levy WTP

In 2010, a 36-inch diameter pipeline was constructed with a conveyance capacity of 16 mgd. The pipeline construction project also included an upgrade at Otay FCF No. 14 to a capacity of 16 mgd. Per the terms of the 2006 agreement between SDCWA and OWD regarding implementation of the East County Regional Treated Water Improvement Program (ECRTWIP), the Levy WTP supplies water to OWD via FCF No. 14 and the pipeline, up to 12 mgd during peak demands and 16 mgd during non-peak demands.

Per the terms of the ECRTWIP, OWD must purchase a minimum of 10,000 AFY of treated water from Helix's Levy WTP. Recycled Water Supply

2.5.4 Ralph W. Chapman WRF

OWD owns and operates the RWCWRF. The RWCWRF provides tertiary treatment for up to 1.3 mgd of wastewater, although in terms of water quality, the reliable continuous treatment capacity of this facility is 1.1 mgd. This facility provides tertiary treated wastewater effluent that meets Title 22 requirements, primarily for landscape irrigation. Wastewater treated at RWCWRF comes from the sewer collection systems of OWD and the County of San Diego. Effluent from this plant that is not put to beneficial reuse is disposed of via the Rancho San Diego Outfall.

2.5.5 City of San Diego South Bay WRP

The SBWRP is owned and operated by the City of San Diego's Metropolitan Wastewater Department. The plant became operational in May 2002, and has a rated treatment capacity of 15 mgd. The effluent receives either secondary treatment for discharge into the Pacific Ocean, or tertiary treatment to meet Title 22 requirements for reclaimed water use. The design allows for tertiary treatment of all flows; of which up to 6 mgd is available for reclaimed use.

In 2003, OWD entered into an agreement with the City of San Diego to receive up to 6 mgd of treated effluent from the SBWRP. In addition, the agreement presents a minimum purchase schedule for OWD on an annual basis. For purposes of this analysis, the supply from SBWRP to OWD was assumed to be limited to 6 mgd. This agreement expires in 2026.

Due to the seasonal fluctuation in reclaimed water demands, it should be noted that the supply from SBWRP will need to exceed 6 mgd during peak summer months in order to satisfy the minimum purchase agreement on an annual basis. However, any supply exceeding 6 mgd is not reliable for planning purposes. Supply from SBWRP was limited to the minimum of reclaimed water demands or 6 mgd, whichever was lower.

2.6 Summary of Existing Supply

A breakdown of the current water supplies available to OWD is shown in Table 2.1. As shown, OWD's supply is 100 percent imported water, with water from Otay WTP and Levy WTP being limited by agreement, and the remaining water being imported via Pipeline No 4 from SDCWA. Recycled supplies are from the RWCWRF and from the SBWRP.

Table 2.1 Water Facility Capacities and Agreements

Supply Source	Baseline Capacity[(1)]	Notes
Imported		
SDCWA's treated water through Pipeline # 4	121.5 mgd	[Capacity]
City of San Diego's Otay WTP	10 mgd	[Agreement]
Helix's Levy WTP	12 mgd On-Peak, 16 mgd Off-Peak	[Agreement]
Total Imported Supply	143.5 - 147.5 mgd	
Recycled		
OWD's Ralph W. Chapman WRF	1.3 mgd	[Capacity]
City of San Diego's South Bay WRP	6 mgd	[Agreement]
Total Recycled Supply	7.3 mgd	

Note:
(1) Data from 2015 WFMP

Section 3

PROJECTED WATER SUPPLY GAP

3.1 Future Water Demands

Future water demand projections provide the context for the evaluation of water supply alternatives and support the development of the IRP. In addition, water demand projections can be used to schedule the timing of water supply investments in order to minimize unnecessary costs. The following is a description of the projected demands used for this IRP for the North, Central Area, and Otay Mesa Systems within OWD's service area.

3.1.1 Annual Average Demand Projections

The total OWD water demand projections for potable and recycled uses are based on projections from the 2015 WFMP, and summarized in Table 3.1. These demands were prepared by Atkins using the SANDAG Series 13 Regional Growth Forecast (2014) for projections in population, housing, and employment. The demand forecast also applies unit use adjustments to account for various factors that may drive reductions and increases in unit water use. As shown in Table 3.1, the total water demand projected for 2050 is 52,000 AFY, with an estimated recycled water demand of 6,200 AFY. Recycled water is projected to account for approximately 12 percent of the total water demand by year 2050.

Table 3.1 Potable and Recycled Water Demand Projections

Forecast Year	Potable Water Demand (AFY)	Recycled Water Demand (AFY)	Total Water Demand (AFY)
2014	33,000	4,400	36,500
2020	37,000	5,400	42,400
2025	38,200	5,600	43,900
2030	39,500	5,700	45,200
2035	40,700	5,900	46,700
2040	42,400	6,000	48,500
2045	44,100	6,100	50,200
2050	45,800	6,200	52,000

Notes:
(1) Projections for 2020, 2035, and 2050 are from the 2015 Water Facilities Master Plan (Draft Median Projections 01/13/2015).
(2) Projections for remaining years in table were calculated using linear interpolation between 2015 WFMP median projections.

OWD's historical and projected potable water demands are presented in Figure 3.1. The projected high, median, and low rates were obtained from the 2015 WFMP. For purposes of this IRP, the median demand projection was used. As shown in Figure 3.1, the water demand forecast prepared for the 2015 WFMP is significantly less for 2050 than the projections from the 2008 Water Resources Master Plan and 2010 Urban Water Management Plan (UWMP). The decrease in demands is a result of a reduction in growth due to the economic downturn that occurred between 2007 and 2010 and increased water conservation by OWD customers.

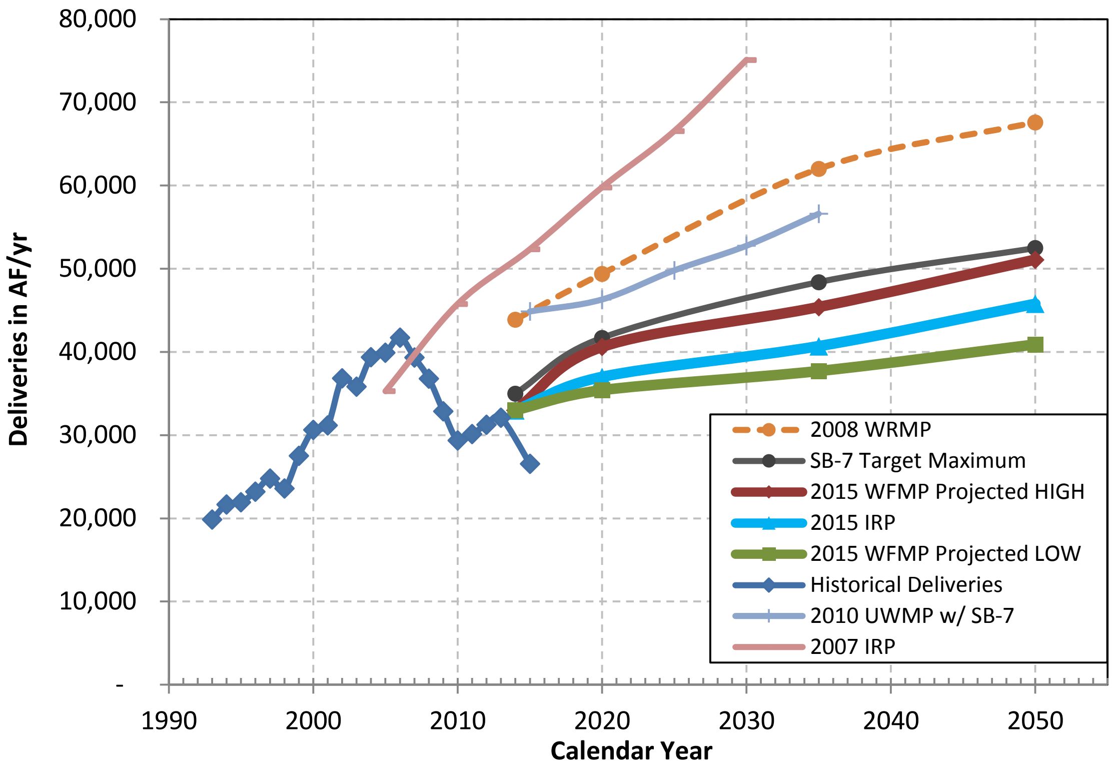


Figure 3.1 Historical and Projected Potable Water Demands (AFY)

For purposes of the IRP, the total OWD demands were divided into demands for the North, Central Area, and Otay Mesa Systems (described in Section 2) based on demand distributions delineated in the 2015 Water Facilities Master Plan. The projected distribution of potable water demand for each system for the years 2015 through 2050 are shown in Table 3.2.

Projected demands for each system (North, Central Area, and Otay Mesa) and total recycled water demands used for the IRP are shown in Figure 3.2. As shown in Figure 3.2, total OWD demands are anticipated to increase in the next 35 years from approximately 37,000 AFY to 52,000 AFY. The increase in demands is expected because the current population of approximately 217,000 persons is expected to grow to approximately 307,877 persons by 2050 (Atkins, 2015).

As shown in Figure 3.2, the Central Area System represents the majority of demands, and has the largest increase in demands over time. According to the 2015 UWMP, the Central area is comprised primarily of major residential developments, while the Otay Mesa area is expected to develop almost exclusively as industrial with small commercial and residential land uses.

Table 3.2 Projected Demand Distributions by System for Potable Water

Forecast Year	Potable Water[1]					
	North		Central Area		Otay Mesa	
	AFY	%	AFY	%	AFY	%
2014	10,000	32%	18,400	58%	3,200	10%
2020	10,300	28%	22,600	61%	4,100	11%
2035	10,600	26%	24,700	61%	5,400	13%
2050	11,100	24%	25,700	56%	9,000	20%

Note:
(1) Source: 2015 WFMP Update (Atkins, 2015)

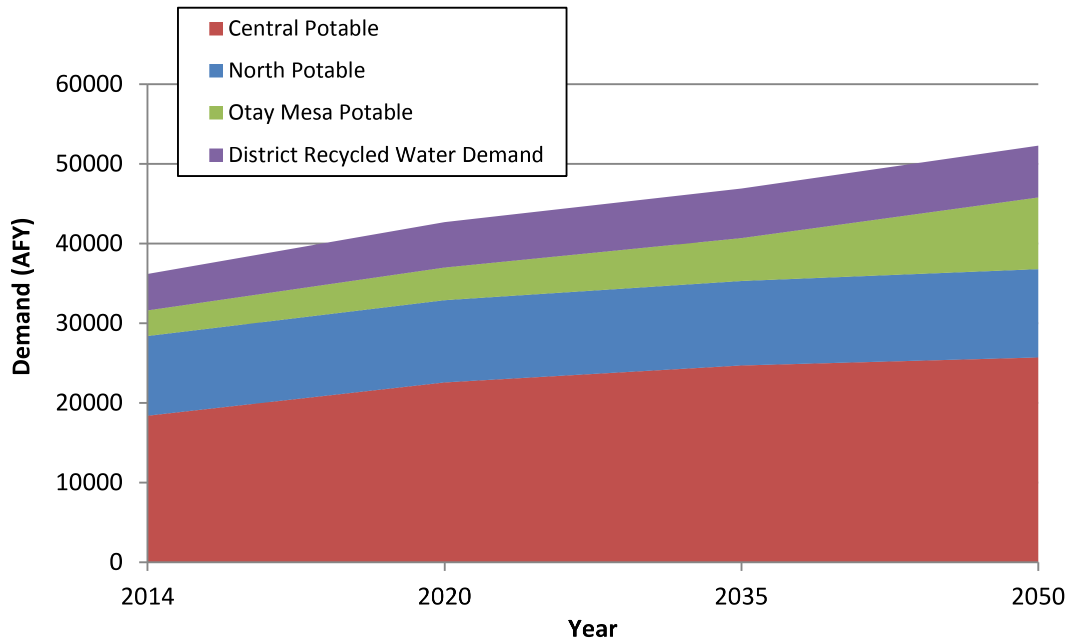


Figure 3.2 Otay Water District Projected Annual Demands

3.1.2 Weather Impacts and Peaking

Water demands are not uniform over time. Rather, water demands at nearly all municipal water agencies exhibit variability on an annual and monthly basis. Annual and seasonal changes in weather affect water demands, and people's lifestyles and business habits affect water demand throughout the year. This variability is subject to random processes, but inherent patterns can be observed over time and used in the planning and management of water supply systems. Annual and monthly water use patterns can be described; and although weather is unpredictable, understanding its range of effects can improve management of water resources.

3.1.2.1 Annual Weather Impacts

When projecting future water demands, it is important to recognize that demands fluctuate year-to-year based on local weather. Water demands are higher in dry-weather years than in average-weather years due to increased landscape irrigation needs and other uses. Additionally, there is uncertainty due to weather and hydrology regarding the amount of imported water available from year to year.

Imported water from the SDCWA and MWD is one of the most variable sources of water supply. This variation is mainly due to hydrology in northern California, which is not always correlated to hydrology in San Diego County. The imported water variability from the Colorado River is tempered by the massive storage within the system (which has over 10 times the storage as the SWP system).

3.1.2.2 Seasonal (Monthly) Impacts

Water demands not only vary from year-to-year, but also from season-to-season. For example, water demands increase during dry summer months as customers irrigate outdoor landscaping more frequently. To account for these seasonal fluctuations in demand, monthly peaking factors were developed by Atkins for the 2015 WFMP. The projected monthly potable water peaking factors for the planning years are shown in Table 3.3.

Table 3.3 Projected Monthly Potable Water Peaking Factors

	Monthly Peaking Factor			
Service Area	2013	2020	2035	2050
North District	1.35	1.33	1.30	1.28
South District	1.29	1.26	1.24	1.21
Total District	1.31	1.28	1.26	1.23

Note:
(1) Source: 2015 WFMP Update (Atkins, 2015)

The factors shown in Table 3.3 are multipliers to be applied to the base demand projections (average annual value). These factors account for fluctuations in demand related to seasonal water use patterns. As shown in Table 3.3, the monthly peaking factors for the total district are expected to decrease from 1.31 to 1.23 over the planning period of 35 years.

Monthly seasonal factors for recycled water demands were given in the 2002 Water Resources Master Plan, and are shown in Figure 3.3. These seasonal variations for recycled water demand originated from the City of San Diego Clean Water Program Reports.

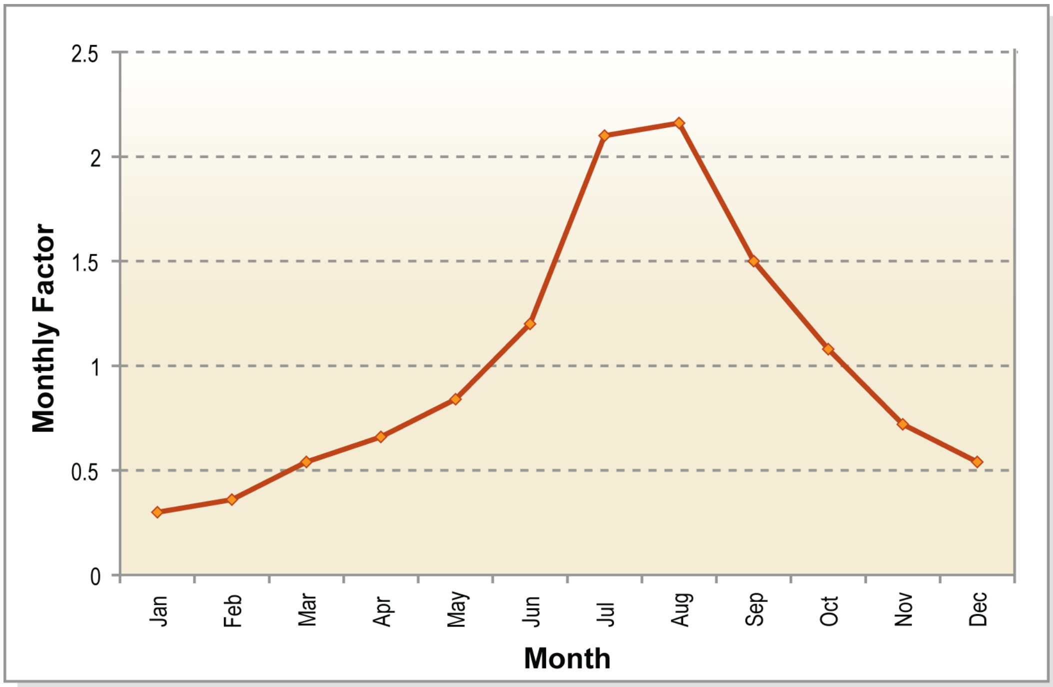


Figure 3.3 Monthly Seasonal Recycled Demand Factors

3.2 Supply Gap Analysis

There is currently sufficient capacity to meet all OWD future demands through purchases of imported water from SDCWA. In that sense, there is no projected supply gap. The projected supply mix for OWD assuming the baseline water supply as discussed in Section 2 is shown in Figure 3.4. It is assumed that imported water purchases are increased to meet system demands.

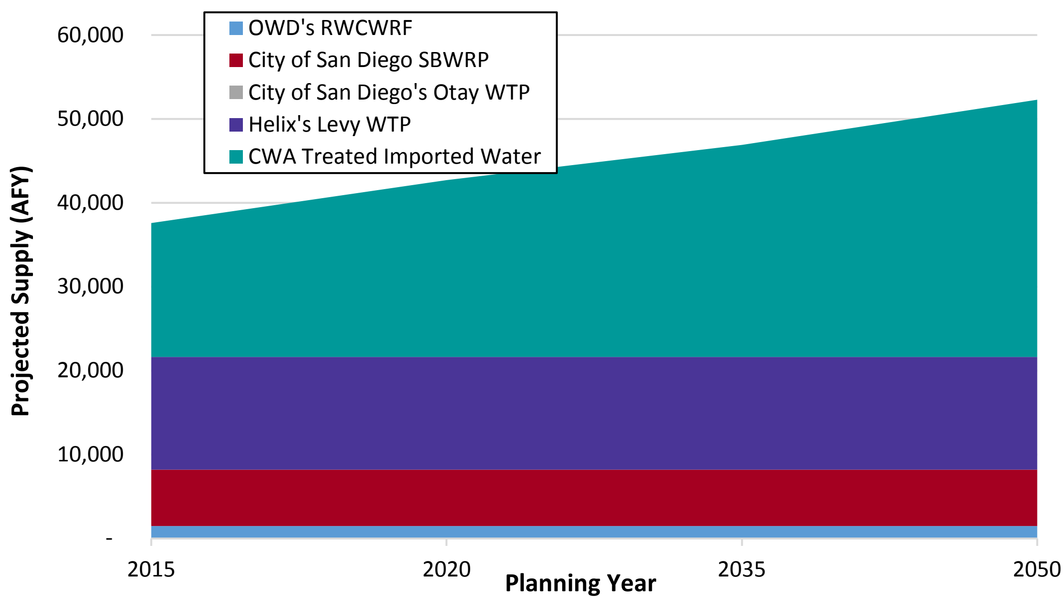


Figure 3.4 Projected Baseline Supply Mix over Time

As can be seen with this baseline case, most of the water used by OWD in the future will come from imported SDCWA water. The OWD objectives for this IRP, however, place emphasis on reliability, flexibility, and diversity and point toward decreasing the dependence on imported SDCWA water supplies. These three objectives and the potential issues associated with the reliability of imported supply (discussed in Section 1), create an opportunity for OWD to develop a more diverse water supply portfolio.

Seasonal variations for recycled water demand create a supply gap during peak summer months. Projections for 2050 place the average daily demand for recycled water at 6,200 AFY and the supply at 7,840 AFY. The SBWRP provides a maximum of 6,725 AFY of the recycled water supply, with the balance coming from the RWCWRF. Using monthly seasonal recycled demand factors from Figure 3.3, a recycled water supply gap is expected in July, August, and September, varying between 1,500 AFY and 6,000 AFY per month. The system has over 40 million gallons of available recycled water storage to supplement the supply during peak demand. Under the highest recycled water demand months, the stored recycled water supply will be depleted in about a week.

Section 4

WATER SUPPLY PROJECTS

In the 2007 IRP, water supply projects were identified that could be used by OWD to meet their long term water management objectives. Additional water supply projects are also being introduced as part of this 2015 IRP Update. Developing supply projects was an iterative process with assistance from OWD personnel. Potential projects were identified through discussion and refinement. Supply projects can be projects, programs, or contractual arrangements with other agencies. The potential projects can be broken down into categories based on the source of the water and the processes required before the water can be used. The categories of supply projects include:

- Conservation;
- Groundwater;
- Imported Water for Potable Use;
- Indirect/Direct Potable Reuse from Local Supply;
- Potable Water Treatment Options;
- Ocean Desalination; and
- Recycled Water for Non-Potable Use.

It should be noted that the characteristics of all supply projects are only intended for planning level evaluations. Although an attempt was made to obtain detailed information and data, in some cases, certain assumptions had to be made based on prior studies and/or professional engineering judgment. The cost estimate for alternatives is not included at this stage of planning because of too many unknowns associated with the projects. Before any supply project is actually implemented, a more detailed investigation may be required.

Since the development of the 2007 IRP, the District has completed preliminary studies for some of the water supply projects identified. Updated information based on these studies is provided herein, including a determination as to whether the supply option is considered viable or not.

In the following sections, the potential supply projects are described. Figure 4.1 provides a map of the locations where each potentially viable water supply source will enter the OWD's service area. The section concludes with a summary of water supply options that are recommended for further evaluation.

The cost of SDCWA water has grown substantially since 2009, as shown in Figure 4.2, with drought conditions as a primary driver of the rate increases. Rates are projected to climb further with the inclusion of the Carlsbad desalination plant expenses.

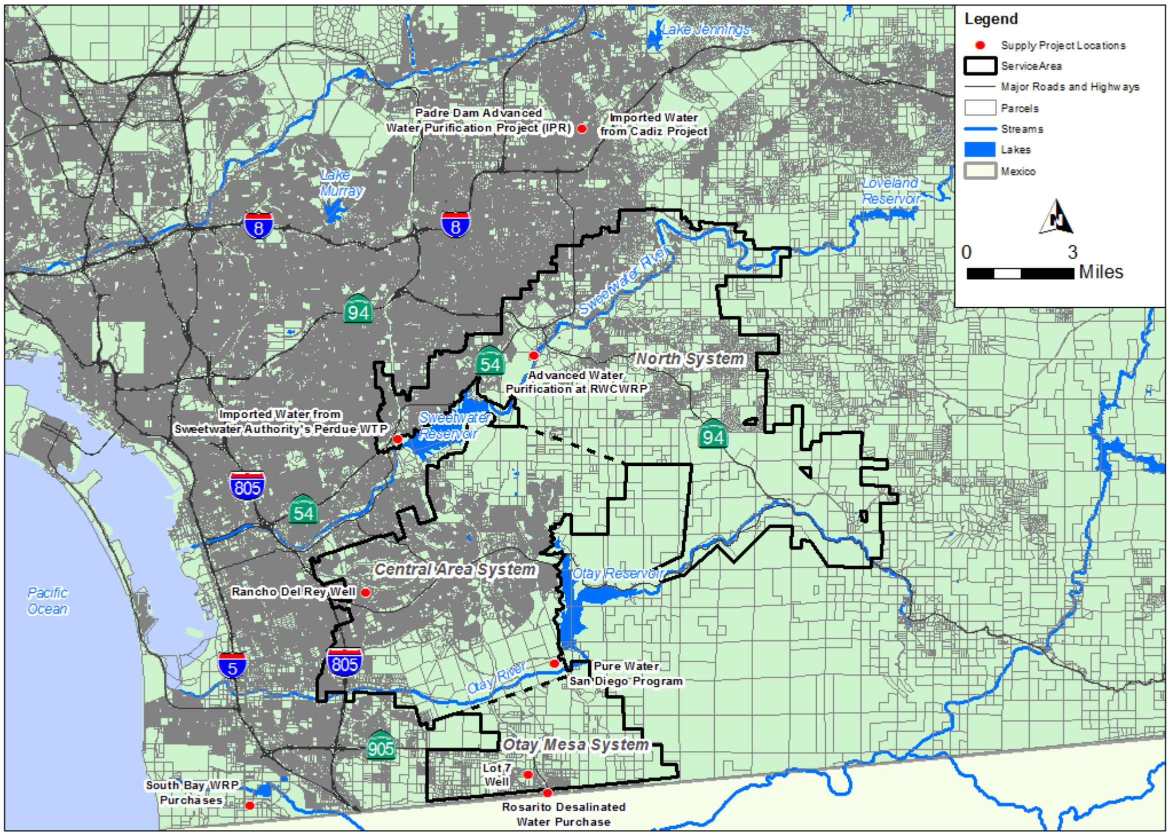
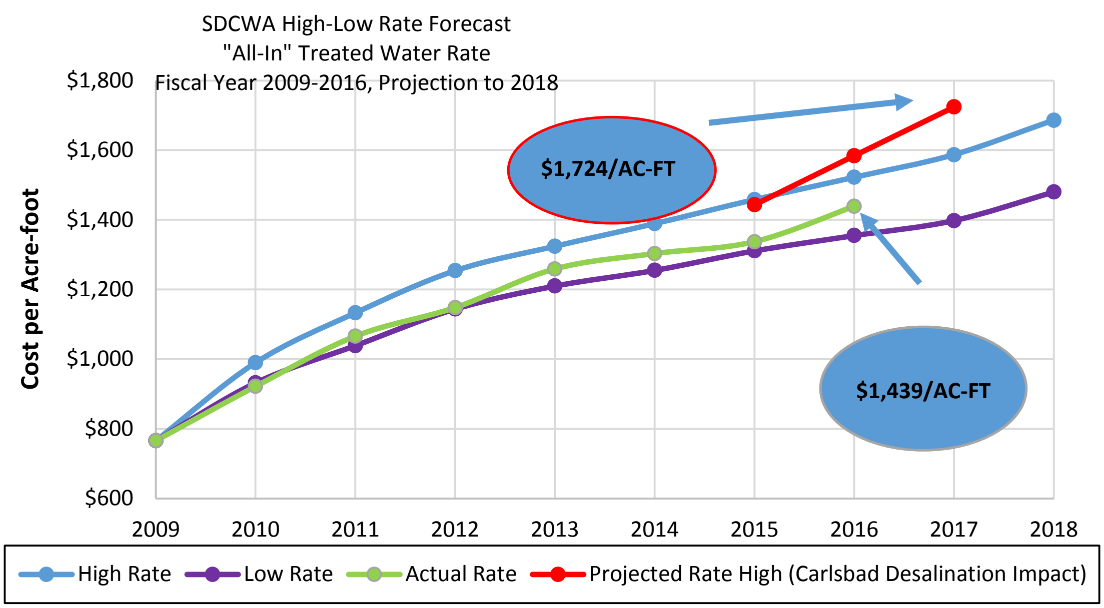


Figure 4.1 Supply Project Locations



(Source: San Diego County Water Authority Proposed Calendar Year 2016 Rates and Charges, Administrative and Finance Committee Meeting, May 28, 2015)

Figure 4.2 SDCWA High-Low Rate Forecast

4.1 Water Conservation

Since 2007, the District has seen a greater interest in water conservation by its customers. This peaked in 2015 with the severe drought when the State Water Resources Control Board adopted mandatory water-use regulations that require immediate reductions in urban water use statewide. These regulations were implemented in May 2015 and required that OWD customers reduce water usage by 20 percent from 2013 demands; the conservation mandate has since been lifted. OWD customer's existing water usage is already well below the SBX 7-7 2020 goal established in the 2010 UWMP. OWD has made great strides in encouraging customers to continue long-term conservation efforts and will continue to include water conservation efforts as part of the water supply planning. Figure 4.3 presents the trend in residential water usage from 1990 through 2015.

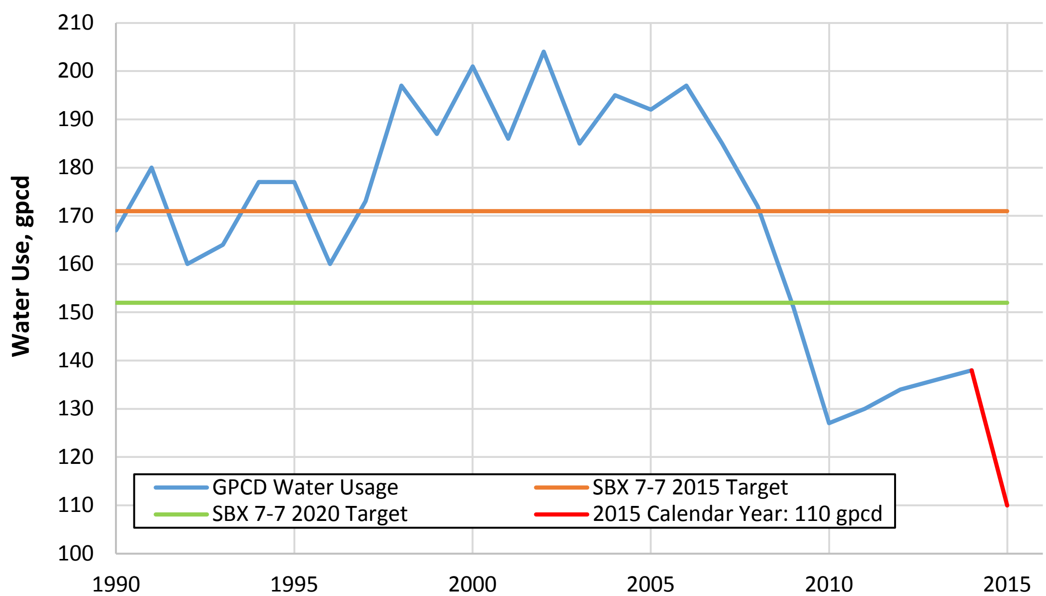


Figure 4.3 Residential Per Capita Water Usage

The OWD has seen a plateau in conservation from the drought declaration and it is unlikely that a further decrease in gallons per capita per day (gpcd) will occur unless conditions worsen.

4.2 Groundwater Projects

Groundwater resources are a potential local supply project, providing more localized control and potentially lower treatment and conveyance costs.

Two general types of groundwater projects were considered:

- Safe-yield groundwater extraction with demineralization
- Conjunctive-use storage of imported water providing a dry year supply.

Groundwater extraction and demineralization could provide OWD with a new local water source, improve system reliability, and contribute toward a gradual improvement in the quality of the basin. Conjunctive use consists of recharging imported water during periods of high availability and recovery during high-demand periods (i.e., summer months), drought, or emergency conditions. This type of project will enhance the reliability of the OWD system.

Several basins were considered for potential groundwater projects because of their proximity to OWD's service area. These include:

- Middle Sweetwater basin
- Lower Sweetwater basin
- Santee/El Monte basin
- San Diego Formation aquifer

Figure 4.4 shows the location of the groundwater basins in relation to the OWD service area. Additionally, a number of small groundwater well projects were considered. These include the Rancho del Rey Well and the Lot 7 Well.

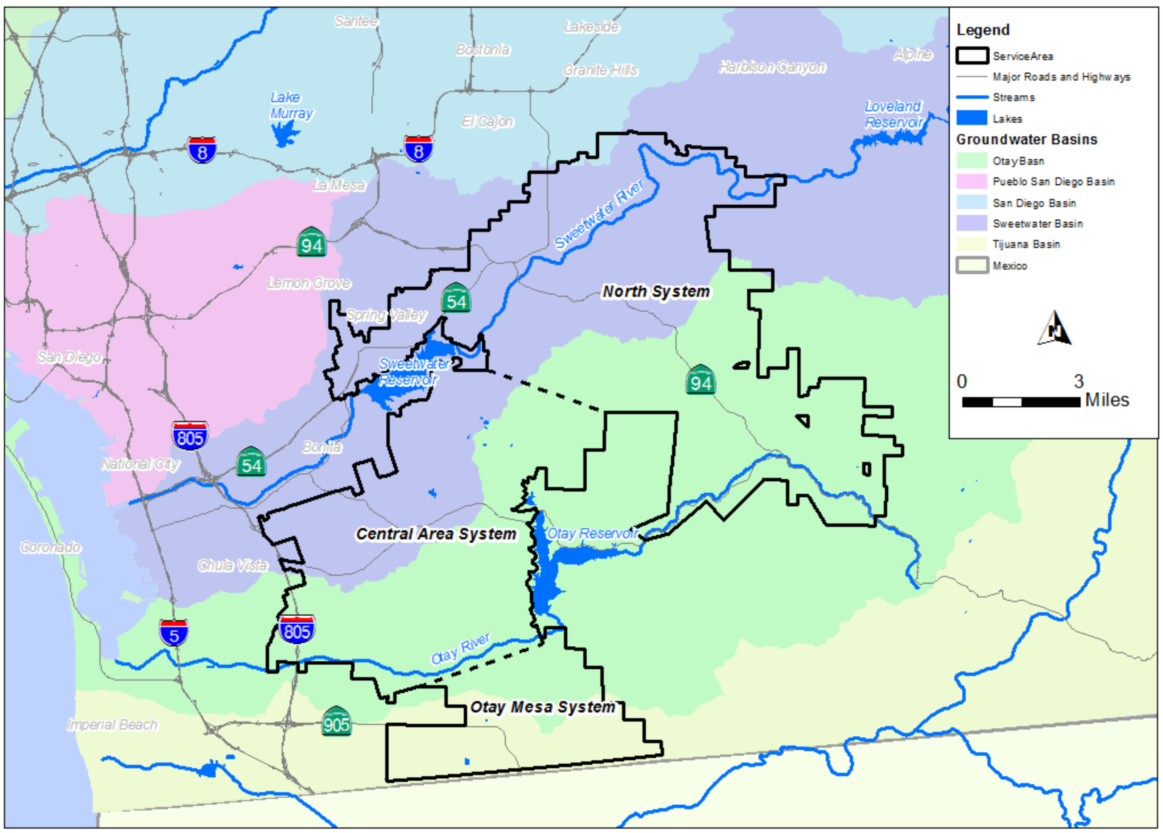


Figure 4.4 OWD Groundwater Basin Study Area

4.2.1 Middle Sweetwater Conjunctive Use

The Middle Sweetwater basin is defined as the 17-mile reach of the Sweetwater River between Loveland and Sweetwater Reservoirs. The basin is located mostly within the OWD service area. This is an alluvial aquifer with a thickness of 20-30 feet in the upstream section, 60 to 150 feet in the middle section, and 10-20 feet in the downstream sections. The depth to the water table is shallow. Its tributary system includes additional alluvial aquifers. The alluvial sediments in the basin are coarse sand and gravel having moderate to high permeability. The alluvium is bordered by slightly-fractured crystalline bedrock which is generally impermeable.

Alluvial storage is approximately 29,000 acre-ft; with approximately 17,000 AF above Singing Hills Golf Course, and 12,000 AF downstream.

Groundwater recharge to the basin is from surface water, such as the Sweetwater River (approx. 2,000 AFY) as well as stormwater and irrigation return flows (approx. 1,600 AFY). Historical water quality data shows that the groundwater in the basin has high concentrations of total dissolved solids (TDS).

The 2007 IRP identified a potential project in which groundwater extraction would occur during dry years to help OWD meet demands in drought conditions. During this time, the water table would be allowed to drop so that the aquifer could be recharged with imported water at a later time.

Figure 4.5 presents the conceptual schematic of this project. For planning purposes in 2007, it was assumed that a 5,000 AFY project may be implemented. The water extracted from the basin would be delivered to the OWD's North System. Filtered replenishment water may be obtained from the abandoned La Mesa-Sweetwater Extension (LSME), as it would require less infrastructure and most likely be less expensive. Alternatively, unfiltered replenishment water may be obtained from the San Diego Aqueduct Pipeline No. 3. For analysis of this project, it was assumed that recovered groundwater quality is sufficient for delivery without demineralization.

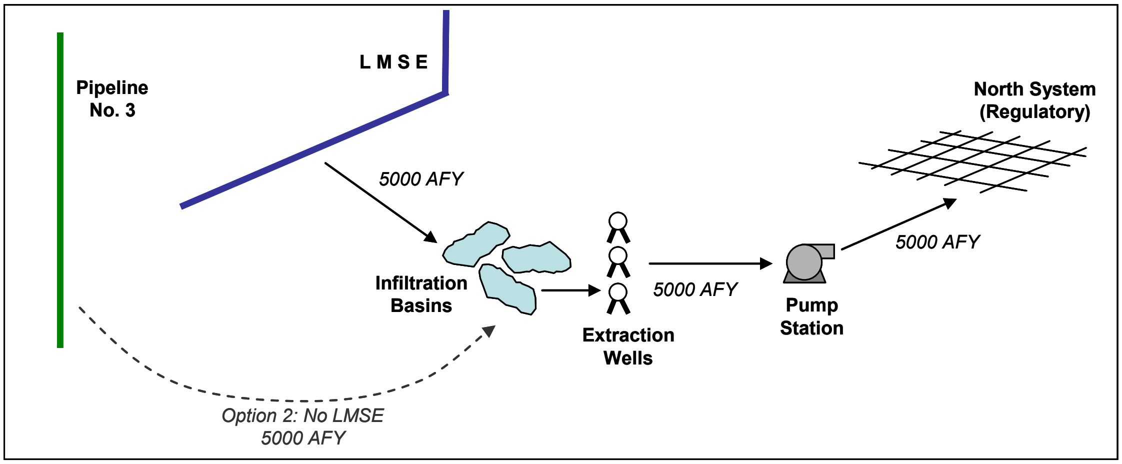


Figure 4.5 Middle Sweetwater Conjunctive Use Project Schematic

As shown in Figure 4.5, the Middle Sweetwater Conjunctive Use project supplies water from either the abandoned LMSE or CWA Pipeline No. 3 to a series of infiltration basins in Sweetwater basin. This water would then be extracted for use in the North System.

The facilities/project components required for this project include:

- Conveyance of water to Middle Sweetwater Basin for recharge
- Infiltration basins
- Extraction wells
- Monitoring wells
- Conveyance of recovered water (pipeline and pumping)
- Land acquisition
- Imported raw water purchases from SDCWA (at the groundwater replenishment rate)

To implement this project, OWD would need to coordinate with the Sweetwater Authority to verify that adverse impacts are not created, and potentially to discuss partnering opportunities. In addition, OWD would need to coordination with SDCWA for delivery of replenishment water at replenishment rates. As this project requires imported water from SDCWA to be stored in the Sweetwater Basin, it should not be considered as a new source of water supply. With the recent improvements completed by SDCWA to raise the dam at San Vicente Reservoir, "dry weather" storage by OWD may not be needed. This water supply option from the 2007 IRP is not recommended as a viable source of supply.

4.2.2 Lower Sweetwater Brackish Groundwater Demineralization

The Lower Sweetwater basin is defined as the 8-mile reach of the Sweetwater River between Sweetwater Reservoir and San Diego Bay, and is located outside of the OWD service area. The basin consists of an alluvial aquifer and the underlying San Diego Formation. There is approximately 13,000 acre-ft of storage in the basin, including the underlying San Diego Formation. The alluvial aquifer consists of sand and gravel, and the depth to groundwater is in the range of 0-20 ft. The net recharge to the alluvial aquifer is estimated to be approximately 1,100 AFY.

Salinity in the alluvial aquifer varies from 1,700 to 3,100 mg/L, while TDS concentrations in the urban runoff recharge water is approximately 2,500 mg/L.

For this project, 1,500 AFY of brackish groundwater would be extracted and treated with reverse osmosis (RO). Assuming a treatment efficiency of 85 percent, 1,275 AFY of treated water would be conveyed to the Central Area System. The RO treatment would generate 275 AFY of brine which could be disposed of in the San Diego County's Spring Valley Trunk Sewer, which ultimately flows to the Point Loma Wastewater Treatment Plant. A conceptual schematic of this project is shown on Figure 4.6.

The facilities/project components required for this project include:

- Extraction wells
- Monitoring wells
- RO treatment plant
- Conveyance for treated water (pipeline and pumping)
- Conveyance for brine disposal
- Land acquisition

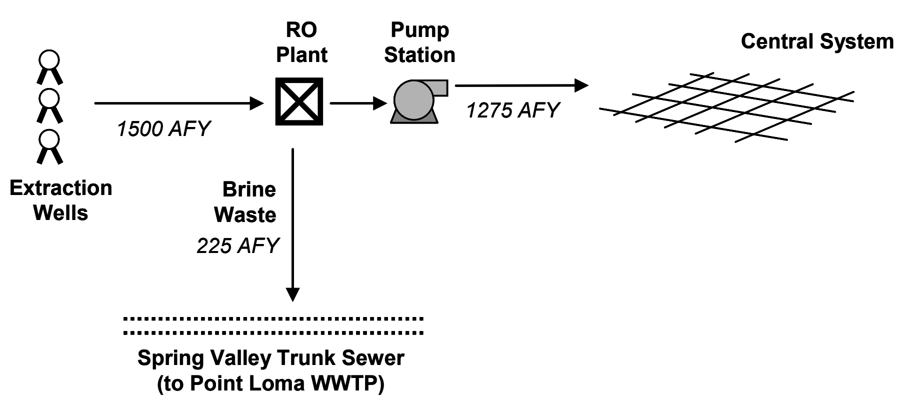


Figure 4.6 Lower Sweetwater Brackish Groundwater Demineralization Project Schematic

Potential issues for the implementation of this project include the need to coordinate with Sweetwater Authority and possibly the City of Chula Vista to obtain access to the basin and locate the required facilities. In the past, Sweetwater Authority has indicated that it would not be interested in pursuing this project. In addition, OWD needs to coordinate with the City of San Diego and the County of San Diego for the use of the sewer system for brine disposal. Brine disposal may in turn impact the salinity of Point Loma effluent and the City of San Diego Pure Water Program and require significant environmental review. Due to these reasons, this project is not recommended for further consideration as a viable water supply project.

4.2.3 Santee/El Monte Basin

The Santee/El Monte basin is located outside of OWD's service area along the San Diego River and mostly in the City of Santee and Lakeside (Padre Dam Municipal Water District). The basin includes an alluvial unit with total storage volume of 55,000 AF, composed of gravel, sand, silt, and clay. This unit is capable of storing and transmitting large quantities of water. The thickness of the aquifer is estimated to range from 50 to 230 feet. The water table is shallow (between 15 and 30 feet below the surface).

The most recent water quality information obtained (1985) indicates that TDS concentrations in the eastern portion of the basin are in the order of 500 mg/L, although much higher concentrations (1,500 mg/L) have been observed. Water quality in the western portion of the basin is worse, with TDS concentrations ranging from 1,500 to 2,000 mg/L.

The 2007 IRP identified two potential water supply projects: imported water conjunctive use and brackish groundwater demineralization.

4.2.3.1 Santee/El Monte Conjunctive Use

With this project, 5,000 AFY of imported water would be recharged to the basin in wetter years and recovered during high demand periods, droughts, or emergency conditions. Recharge water could be obtained from raw water from the San Vicente Reservoir via the El Monte Pipeline. However, there may be limitations due to conveyance capacity.

It was assumed that the basin would be recharged with raw water from the San Vicente Reservoir conveyed via the El Monte pipeline. The replenishment water would percolate into the ground through infiltration basins and then be extracted and conveyed to the North System. A conceptual schematic of this project is shown in Figure 4.7.

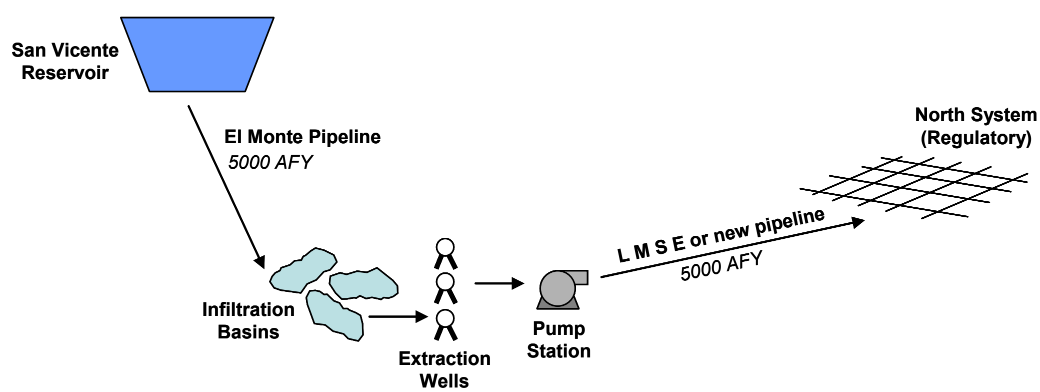


Figure 4.7 Santee/ El Monte Conjunctive Use Project Schematic

Similar to the Sweetwater Conjunctive Use Project, a significant amount of infrastructure would be required including:

- Conveyance of replenishment water
- Infiltration basins
- Extraction wells
- Monitoring wells
- Conveyance of recovered water (pipeline and pumping)
- Land acquisition
- Imported raw water purchases from SDCWA (at the groundwater replenishment rate)

Potential implementation issues for this concept project include the need to coordinate with the city of San Diego, Padre Dam MWD and other jurisdictions located within the basin for the use of the basin and to address any potential water rights issues. Coordination with SDCWA will also be required for obtaining replenishment water and for potentially using some of its infrastructure. This project would not be considered a new supply source as it is only the storage of imported SDCWA water for dry-year use. Due to the expected cost of the infrastructure required, this project is not considered to be viable in the future.

4.2.3.2 Santee/El Monte Brackish Groundwater Demineralization

This concept project entails extracting and treating 5,000 AFY of brackish groundwater with reverse osmosis throughout the year. According to available literature, the safe yield of the basin ranges from 1,650 to 5,500 AFY. Approximately 5,600 AFY of groundwater is currently being extracted from the basin by municipal (1,600 AFY) and agricultural users (4,000 AFY). With an assumed treatment efficiency of 85 percent, 4,250 AFY would be delivered to the OWD distribution system and 750 AFY of brine concentrate. The brine concentrate could be disposed of in the City of San Diego Metropolitan Wastewater District (Metro) Mission Gorge Sewer Line, and ultimately discharge at the Point Loma Ocean Outfall.

The treated groundwater would be delivered to the North System by new conveyance facilities. A conceptual schematic of this project is shown in Figure 4.8.

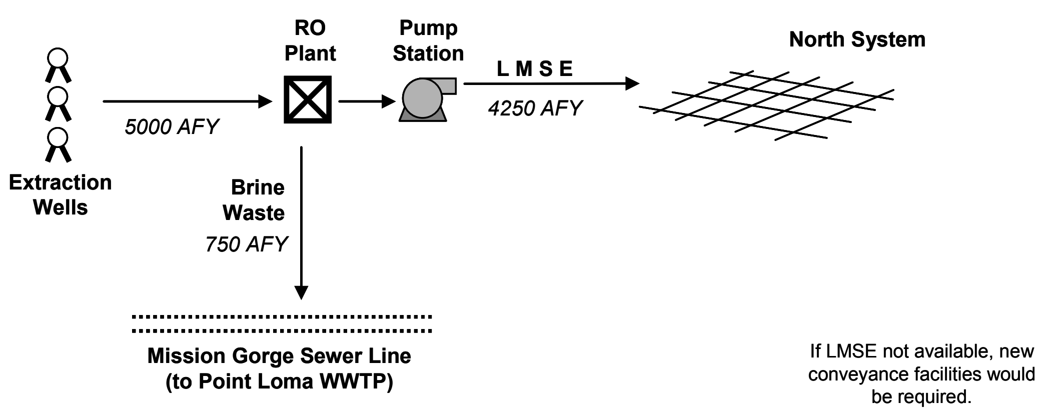


Figure 4.8 Santee/El Monte Brackish Groundwater Demineralization Project Schematic

The facilities/project components required for this project include:

- Extraction wells
- RO treatment plant and brine disposal facilities
- Conveyance of treated water (pipeline and pumping)
- Monitoring wells
- Land acquisition

The ability for OWD to extract and treat groundwater would depend on the actual current safe yield and use of the basin. Additionally, there might be water rights issues precluding OWD from obtaining this water. This issue might be resolved by extracting brackish groundwater for demineralization and replenishing the aquifer with better-quality imported water. This configuration will over time improve the quality of the aquifer.

Brine disposal will be an important consideration for project implementation and will require significant environmental review and coordination with Metro. Also of concern is the high cost for capacity through Metro and the potential impact to the City of San Diego Pure Water Program. Due to these reasons, this project is not recommended for further consideration as a water supply option.

4.2.4 San Diego Formation Brackish Groundwater Demineralization

The San Diego Formation aquifer underlies the South Bay and extends approximately two miles north and inland to Mission Bay. Most of the aquifer is outside of the OWD service area. Refer to Figure 4.4 for the groundwater basin location.

According to available literature, the estimated safe yield of the aquifer is up to 10,000 AFY. The brackish water from the San Diego Formation contains high levels of dissolved solids; therefore, demineralization would be required.

The 2007 IRP project considered extraction 2,500 AFY of groundwater from the San Diego formation for demineralization by reverse osmosis. Approximately 2,125 AFY would be delivered by pipeline to the Central Area System and 375 AFY of brine concentrate would be sent to the San Diego County's Spring Valley Outfall, and ultimately discharge at the Point Loma Ocean Outfall.

A conceptual schematic of this project is shown in Figure 4.9.

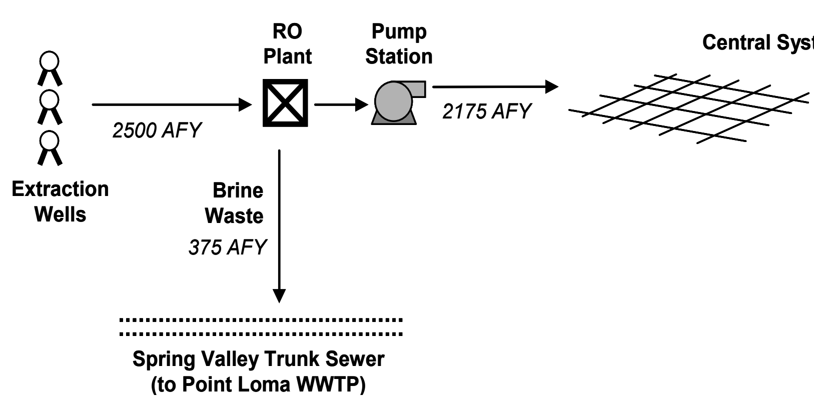


Figure 4.9 San Diego Formation Brackish Groundwater Desalination Project Schematic

The facilities/project components required for this project include:

- Extraction wells
- RO treatment plant (with brine disposal facilities)
- Conveyance to distribution system (pipeline and pumping)
- Monitoring wells
- Land acquisition

Potential issues for project implementation include seawater intrusion, interference with other users of the basin, such as Sweetwater Authority, and brine disposal. Additional extraction from the Formation is currently being developed by the Sweetwater Authority with the expansion of its Reynolds Desalination Facility. Brine may affect the salinity of the Point Loma effluent and impact the City of San Diego Pure Water Program and will be an important consideration for project implementation as significant environmental review and coordination with Metro will be required. Due to these reasons, this supply source should not be considered viable in the future.

4.2.5 Rancho Del Rey Well

In 1997, OWD purchased property within the City of Chula Vista, southeast of the intersection of Rancho del Rey Parkway and Terra Nova Drive, with an existing brackish groundwater production well on site. In 1999, OWD split the property and sold the excess land. At the time the property was purchased, the Project was considered economically unfeasible. Consequently, the Project was temporarily suspended.

In 2010, a new production well was constructed by AECOM Technical Services, Inc. (AECOM). After development of the well, AECOM recommended that 450 gpm (725 AFY) maximum safe yield pumping rate be used for design purposes. Subsequently, staff contracted with Separation Processes, Inc. (SPI), a well-known membrane treatment firm, to conduct a feasibility study for the Project. In April 2011, the Board awarded a professional services contract to Tetra Tech, Inc. (Tetra Tech) to design the treatment plant facility. Tetra Tech has completed the design to the 90 percent level; however, the design was placed on hold in 2014 due to uncertainty associated with the Rosarito Desalination project, SDCWA/Poseidon Resources current draft water purchase agreement, SDCWA and Metropolitan Water District of Southern California treated water rate increases, SDG&E rate increases and the increase in the cost to at least double the cost of SDCWA water.

The existing asset consists of a production well, monitoring well, and 12,000 square foot parcel. The production well consists of a 30-inch mild steel conductor casing starting at the ground surface to 55 feet below ground surface, 12-inch stainless steel well casing starting at the ground surface to 903 feet below ground surface, and gravel packing and cement/bentonite seals. The 12-inch stainless steel well casing was installed with stainless steel screens at three intervals (278′ to 638′, 658′ to 768′, and 788′ to 903′ below ground surface). The pump tests indicated that the safe yield of the production well is approximately 450 gallons per minute. The 5-barrel monitoring well was installed approximately 20 feet from the production well. The monitoring well consists of a 30-inch mild steel conductor from the ground surface to 50 feet below ground surface, five (5) 4-inch well casings terminating at varying depths, and gravel packing and cement/bentonite seals. The monitoring well casings consist of 4-inch ID PVC well casings and stainless steel screens at varying depths.

The Rancho Del Rey well could produce up to 600 AFY.

4.2.6 Lot 7 Well

The groundwater well at Lot 7 in the Tijuana groundwater basin is located in Otay Mesa near the border between the United States and Mexico. The existing asset consists of 10-inch diameter casing with a total depth of 1,041 feet. No perforations were found on the casing, but the bottom is open. The static water level was at 431 feet (in 2001).

An assessment completed for the site in 2001 concluded the water quality does not meet requirements for a municipal supply due to chloride and TDS levels above the maximum contaminant limit (MCL) established by the US EPA. The well could produce 320 AFY, but would require reverse osmosis and brine disposal, which would be expensive. Lot 7 well is not viewed as a strong candidate for implementation in the near future due to its high development and operational costs and low yield.

4.2.7 Other Groundwater Wells

Additional local groundwater well projects were identified in the 2007 IRP. These projects included groundwater extraction wells, treatment facilities, and conveyance to the OWD distribution system from the following sites: Daley Ranch well, Otay Mesa Yard well and the Otay Mountain well site. For the Otay Mesa Yard well, limited information was available, but there was strong concern about poor water quality (in the form of high TDS concentrations) at the site. Advanced treatment with reverse osmosis would be required, which is very expensive for such a small yield, estimated to be approximately 400 AFY. For the Daley Ranch site, there was concern about institutional coordination and wildlife losses. Information for the Otay Mountain well site is based on an agreement between OWD and D&D Landholdings for the exploration, production, and sale of potable water and water rights. The Otay Mountain well is located near the intersection of Otay Mesa Rd. and Alta Rd. The water quality at this well is characterized by high TDS and would thus require demineralization treatment before the water could be used. Brine disposal will be an issue for each well supply project discussed. For these reasons, it is concluded that there may be too many obstacles to overcome to make groundwater a viable supply resource in the future.

4.3 Imported Raw Water for Potable Use (Cadiz Project)

The Cadiz Valley Water Conservation, Recovery, and Storage Project are a two part project wherein Cadiz, Inc. would construct a wellfield on the Cadiz Valley property in the Mojave Desert. Recovered groundwater would be conveyed to participating water providers from the wellfield via a 43 mile pipeline to the Colorado River Aqueduct. Participating water providers will also have the ability to decrease or forego their water delivery in certain years, such as wet years, and carry it over to future years when it may be needed. This carry-over water would be stored in the aquifer at Cadiz Valley. It is anticipated that up to 50,000 AFY will be made available for purchase. For the 2015 IRP Update, it is assumed that OWD's purchase amount would be 5,000 AFY.

For this water supply source, OWD would need to coordinate between Metropolitan Water District and SDCWA to transport the raw water to OWD. In addition, the raw water from Cadiz Valley would require treatment for potable use which could be paired with the Levy WTP as part of the East County Regional Treated Water Improvement Program.

A conceptual schematic of this project is shown in Figure 4.10.

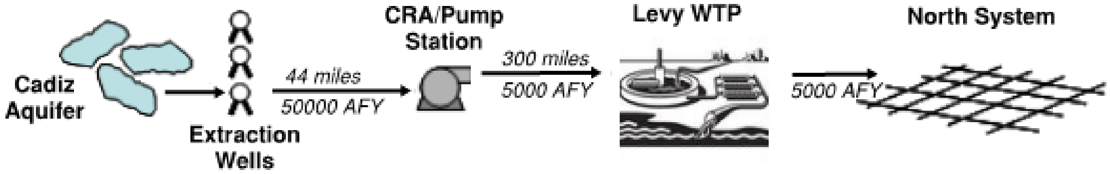


Figure 4.10 Cadiz Project Schematic: Imported Raw Water for Potable Use

4.4 Indirect/Direct Potable Reuse with Local Supply

In addition to the expansion of the direct use of recycled water through Title 22 uses, recycled water can be utilized for indirect potable reuse (IPR) or direct potable reuse (DPR) projects. As each acre-foot of recycled water use can only be utilized for one of these projects, the pros and cons of each project application need to be considered when deciding how much recycled water should be utilized for purple pipe expansion and how much should be reserved for IPR/DPR.

Because California is currently amidst a severe drought and continuously faces the challenge of water shortages and population increases, measures to mitigate the dependence on imported water are critical as water rates continue to increase and supplies become limited.

4.4.1 Partnership with PDMWD's Advanced Water Purification Project

Potable reuse has been successfully utilized for more than 30 years to augment aquifers and surface-water supplies. Padre Dam Municipal Water District (PDMWD) is actively pursuing the expansion of its recycled water program through a potable reuse project to increase water supply reliability.
The PDMWD is currently in the process of implementing an advanced water purification (AWP) demonstration project to establish the requirements for a full-scale AWP project. The full-scale potable reuse project would be executed in two phases.

Phase 1 would include expansion of the water recycling facility (WRF) from 2 mgd to 6 mgd and construction of a 2.2-mgd AWP facility. The AWP effluent would recharge the Santee Basin aquifer and augment water supply at Lake Jennings. The recharged AWP water would be extracted for potable water usage, and the augmented water would be blended with other sources of surface water and treated at the Levy WTP.

Phase 2 would include expansion of the WRF to 21.0 mgd, of which 11.6 mgd would be used for surface-water augmentation of Lake Jennings, owned, and operated by the Helix Water District. The lake water would then be treated at the Levy WTP.

Together, the two projects would provide 13.8 mgd of new potable water supply for East San Diego County. Infrastructure elements required for the project are shown in the conceptual plan in Figure 4.11.

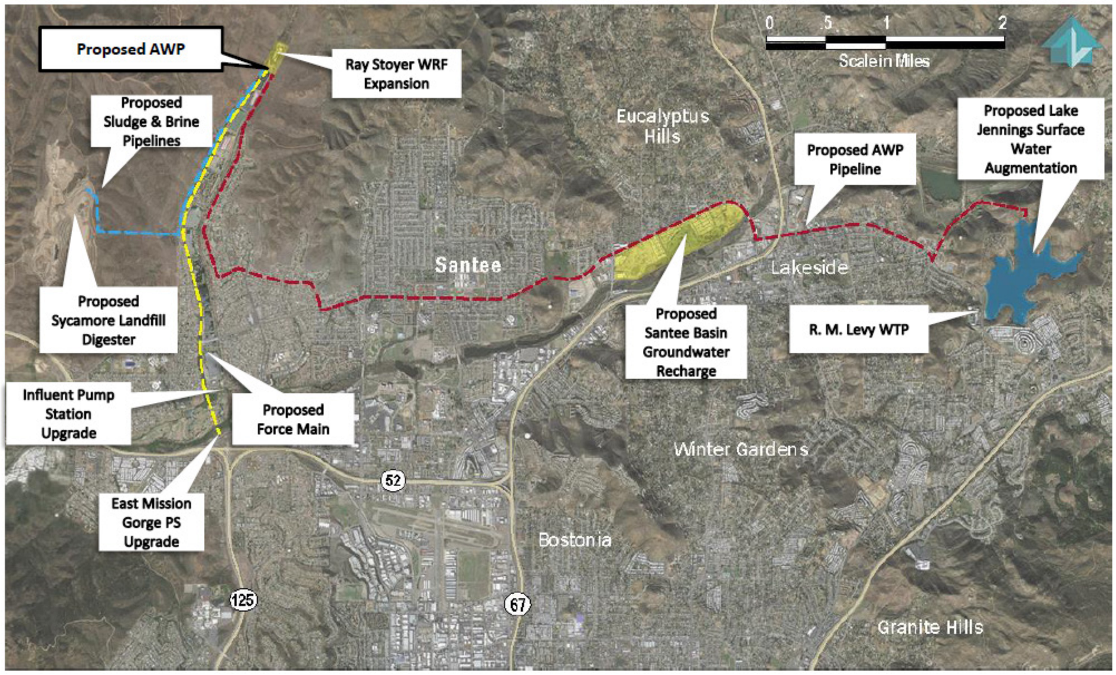


Figure 4.11 Proposed Advanced Water Purification Infrastructure

The advanced treated water would be sent to the Santee Basin for groundwater recharge through the use of a combination of injection and extraction wells. The recharged recycled water would help replenish the local groundwater basin, which would later be extracted for potable water usage. The program concept for the recharge of the Santee Basin is shown in Figure 4.12.

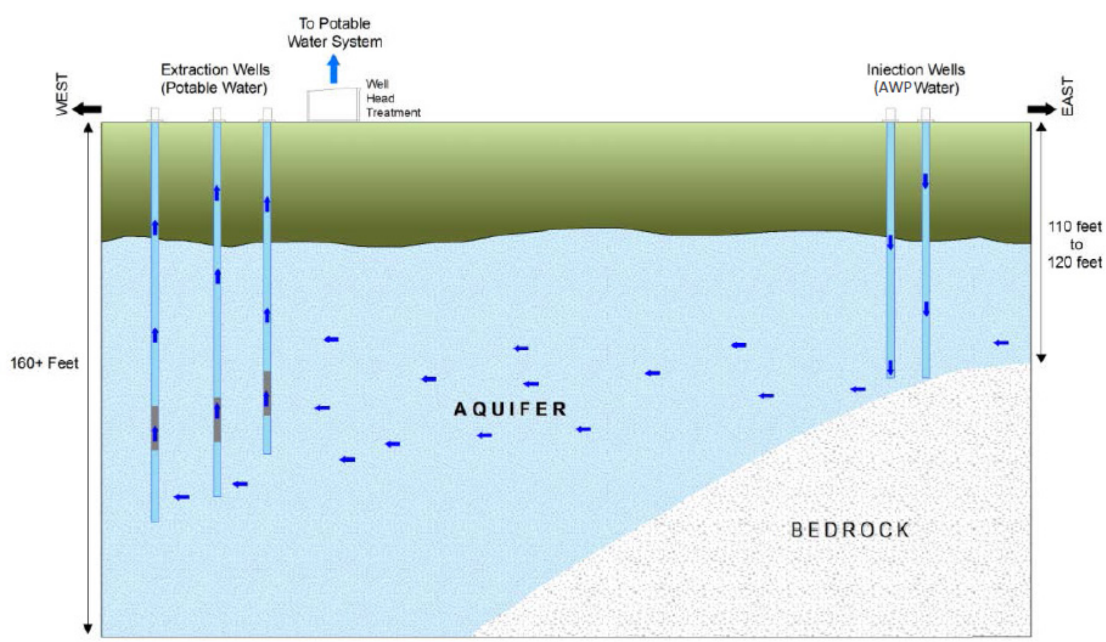


Figure 4.12 Santee Groundwater Recharge Program Concept

An alternative, pending acceptance by the State Water Board, advanced treated water could be used for reservoir augmentation in Lake Jennings. Lake water would be treated by the existing Levy WTP.

Under this project, coordination and agreements would be required with PDMWD, Helix Water District, SDCWA, and other regulatory agencies. It appears that the proposed quantity of IPR water comprises about 10% of the Levy WTP capacity. It is not known at this time if PDMWD would keep rights to all of this water or what interest other Districts have in procuring rights to a portion of it.

4.4.2 Advanced Water Purification at RWCWRF or Spring Valley Stripping Plant

Under this project, the RWCWRP would be upgraded to include an advanced water purification facility (AWPF) or a new stripping plant and AWPF would be constructed where more sewer flows are available. The advanced treated water would be sent to Sweetwater Authority's Sweetwater Reservoir and blended prior to treatment at the Perdue Water Treatment Plant. OWD would potentially have the option to either buy treated water from the Sweetwater Authority or trade for raw water from SDCWA.

Coordination between Sweetwater Authority, County of San Diego, and regulatory agencies would be required to make this project viable. In addition, additional studies regarding the available storage capacity in Sweetwater Reservoir and advanced treatment alternatives for RWCWRF is needed. It is anticipated that the economies of scale will make an IPR/DPR project at RWCWRF unlikely due to the low quantities of water available. Preliminary investigations place the costs for RWCWRF IPR/DPR water at over $4,500/AF.

4.4.3 Pure Water San Diego Program

The City of San Diego's Pure Water San Diego is a phased, multi-year program to use advanced water purification to produce a local, drought-resistant water supply for San Diego. The program involves the design and construction of full-scale water purification facilities throughout the City of San Diego with a goal to ultimately produce 83 mgd of purified water. Phase Two of the program may potentially include a new AWPF at the South Bay WRF that would be used to augment and blend with supplies in Otay Reservoir. Water treatment for potable use would be provided at the City of San Diego's Otay WTP. For this water supply option, OWD could contribute funding for the project and in return receive a portion of the treated water.

Coordination between the City of San Diego and regulatory agencies would be required to make this project viable. Additional planning studies are needed to determine OWD's ultimate project participation level.

4.5 Ocean Desalination

Desalination uses reverse osmosis technology to remove water molecules from seawater. Water from the ocean is forced through tightly-wrapped, semipermeable membranes under very high pressure. Salt and other impurities in the seawater do not pass through the membranes and are discharged from the facility.

In December 2015, the SDCWA added desalinated seawater to its water supply portfolio with the start of operations at the Claude "Bud" Lewis Carlsbad Desalination Plant, the nation's largest seawater desalination plant. The drought-resistant supply produces approximately 10 percent of the County of San Diego's water demands and reduces the dependence on water from the Colorado River and Bay-Delta.

4.5.1 Rosarito Desalination Plant

The Rosarito Desalination Plant is a planned 100 mgd seawater reverse osmosis desalination plant to be located Rosarito Beach, Mexico. The plant would be the largest desalination plant in the Western Hemisphere. In 2014, the State of Baja California passed legislation to approve public-private partnership that allow for the direct negotiations of the State with private companies. The Secretaria de Infraestructura y Desarrollo Urbano del Estado (SIDUE), a State agency that coordinates infrastructure projects for the State and the Comisión Estatal del Agua de Baja California (CEA), an agency that is responsible for regulating the State's water and sewerage industry, issued a public invitation to tender for the production and conveyance of desalinated water produced in Rosarito Beach and operated for a period of 37 years. The State of Baja California is also considering selling to the District desalinated water.

The State of Baja California wants to pursue this project because Tijuana is currently exceeding their water allocation from the Colorado River. Today, Tijuana is about 1.2 cubic meters per second short (approximately 30,000 acre-feet per year) and must negotiate with the farmers in the Mexicali Valley on a yearly basis to acquire the additional water to meet its demands.

The plan is to build the project in two (2) or more phases. The first phase would provide product water to satisfy the demands for Mexico (Tijuana and Rosarito). The State of Baja California is expected to decide on the first phase sometime mid-2016 and construction could be completed by 2020. Future phase(s) would produce excess water for sale to the District. A designated pipeline will carry desalinated water to the District and the water would meet California water quality standards.

OWD has expressed an interest in acquiring a minimum of 13 mgd of desalinated water to augment supply. This will require the involvement and consent of the federal governments of both nations, likely through the International Boundary and Water Commission (IBWC) and Comisión International de Limites y Agua (CILA).

The proposed project would enable OWD to import and convey desalinated seawater from a connection point at the United States-Mexico border north to the District's existing Roll Reservoir on Otay Mesa. The proposed location for the desalination pipeline is shown in Figure 4.13.

A Draft EIR/EIS has been prepared for the work north of the border and also in support of a Presidential Permit which was initiated in November, 2013, when the District submitted an application letter to the United States Department of State. A Presidential Permit could be granted late 2016.

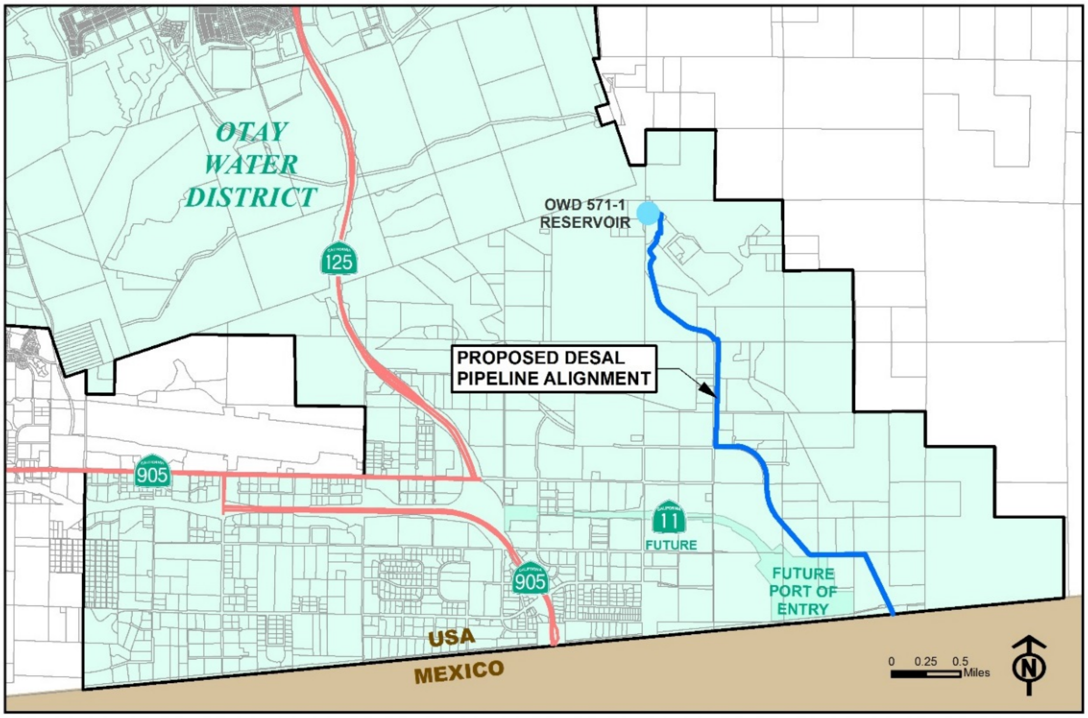


Figure 4.13 Proposed Route for Desalination Pipeline

4.6 Recycled Water For Non-Potable Use

Recycled or reclaimed water can be used to meet select irrigation demands in place of potable water at considerable cost savings and while utilizing an otherwise discarded resource. Recycled water supplies can be used for the irrigation of golf courses, municipal parks, school grounds, highway medians, housing developments, and other large landscaped areas.

4.6.1 Chula Vista Stripping Plant

For this project, OWD would team with the City of Chula Vista to construct a tertiary treatment facility to produce Title 22 recycled water. The recycled water would be delivered to meet recycled water demands in OWD's Central Area.

In 2012, the City of Chula Vista (Chula Vista) and OWD partnered for a study to develop alternatives for the City of Chula Vista to increase its wastewater treatment and disposal capacity with a Chula Vista-owned facility. The new facility would provide Title 22 recycled water to OWD for delivery to customers in the Central Area. Under this project, Chula Vista would phase the construction of a new 6 mgd wastewater treatment plant to coincide with the pace of population growth and increase in sewer flows.

Infrastructure required for this project includes a pump station and a transmission pipeline to convey recycled water from the Chula Vista Wastewater Treatment Plant to the Central Area System.

This project would require coordination with the City of Chula Vista, the County of San Diego, as well as the City of San Diego.

4.6.2 Additional Purchases from and Expansion of South Bay WRP

The City of San Diego's Metropolitan Wastewater Department owns and operates the SBWRP. The SBWRP has a rated capacity of 15 mgd and is located at Monument and Dairy Mart Roads near the international border, adjacent to the Tijuana River. The SBWRP scalps flow from the existing interceptor system that conveys flow northward to the Point Loma Treatment Plant for treatment and ocean outfall disposal.

The agreement between OWD and the City of San Diego for purchase of recycled water from the SBWRP was finalized on October 20, 2003. In accordance with the agreement, the City of San Diego will provide an annual amount of up to 6 mgd of recycled water to District. The term of the agreement is 20 years from January 1, 2007. Under this water supply option, OWD would acquire an additional 4 mgd of SBWRF recycled water (for a total of 10 mgd).

No infrastructure would be required for the additional purchase of recycled water from SBWRP but the City of San Diego's Pure Water Program may impact OWD's opportunity to purchase additional recycled water from the SBWRP in the future.

4.7 Recommended Water Supply Options

Table 4.1 presents the recommended water supply projects that OWD should continue to research as the need for local supplies increases. These projects could help meet the OWD's IRP objective to leverage water supply options between dependency on SDCWA with expanding local water supplies that can provide high reliability with lower costs and rate stability.

The projects listed under the IPD/DPR with Local Supply and the Recycled Water for Non-potable Use source types have the potential to be reliable local water supplies. Advanced water purification would enable recycled water to improve local supply reliability. The projects listed require multi-agency coordination and funding.

The recycled water for not-potable use projects would increase amount of recycled water available for irrigation demands. Increasing the quantity of recycled water currently purchased from SBWRP would not require additional infrastructure but might be impacted by the City of San Diego's Pure Water Program. The option for OWD to construct a new tertiary treatment facility in Chula Vista jointly with the City of Chula Vista would create a new supply of recycled water for the Central Area.
The construction of the Rosarito Desalination plant could provide a drought-resistant supply option to OWD's portfolio. The first phase of the project is focused on producing recycled water for local use within Mexico, with subsequent phases intended to produce water for purchase by the District. This project requires coordination between the federal governments of United States and Mexico.

Local groundwater sources are not highly recommended for expanding the water supply. Their further investigation for development is only recommended if the other alternatives indicated are not found to be viable. The primary reasons making the groundwater options less attractive include: water quality issues and treatment requirements, and potential difficulties with brine disposal.

Table 4.1 2015 IRP Recommended Water Supply Projects

Source Type	Supply Project	Description
IPR/DPR with Local Supply	PDMWD's Advanced Water Purification Project	Contribute funds for construction of AWFP
	Advanced Purification at RWCWRF or Spring Valley Plant	Upgrade RWCWRF to advanced purification facility or construct a new AWPF where more sewer flows are available, augment supplies in Sweetwater Reservoir
	City of San Diego's Pure Water Program	Contribute to AWPF at South Bay WRP that would augment water supplies in Otay Reservoir
Ocean Desalination	Rosarito Desalination Project	Purchase water from Rosarito's planned ocean desalination plant
Imported Water for Potable Use	Cadiz Water Conservation, Recovery, and Storage	Purchase 5,000 AFY from Cadiz Valley
Groundwater	Rancho del Rey Well	Produce up to 600 AFY (requires treatment and brine disposal)
	Lot 7 Well	Produce up to 320 AFY (requires treatment and brine disposal)
Recycled Water for Non-potable Use	City of San Diego's South Bay WRP	Increase amount of recycled water purchased at SBWRP
	Chula Vista MBR	Joint City of Chula Vista/OWD tertiary treatment facility to produce Title 22 recycled water

Appendix A

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